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A MINERALOGIST'S OBLIGATION*

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Since our modern industrial society apparently creates more needs in everyday life than there are means to supply those needs, a prime goal of a people is to increase the means to supply, so that the standard of living may be raised and a happier life attained. Fundamental to this development is the raw-material of which tools and commodities are made. Men and nations have been made much more conscious of the availability of critical raw-materials in recent years. Even comparatively popular magazines and Sunday newspaper editions discuss the subject for the man on the street. The impact on him of such shortages as rubber and tin, supported by a few quoted government statistics on other shortages, places him in a receptive frame of mind to regard the solution of the raw-materials problem as a panacea to the world's present ills. Important though the raw-materials problem admittedly is, we must avoid the rationalizations which easily emerge from a cursory study of their statistics. Nevertheless, it is folly to deny the full pre-eminent importance of raw materials in the present world picture. They must remain basic to any analytical discussion. They alone do not create the higher standard of living for which, as increasing numbers now believe, the world conflict is being waged, but without them a high standard of living is not possible. Right or wrong, much respected prevailing thought is focusing on the raw-materials problem as the one which, if unsolved, may preclude any great improvement in world conditions.

Outstanding on any list of raw-materials are the minerals. And on a list of strategic raw-materials the minerals occupy a position of unique importance. Official statistics indicate that not even the United States, the most favored nation in its raw-material supply, is independent of sources beyond the national boundaries. Other countries are variously

* This presidential address was not delivered orally because of the cancellation of the annual meeting.

† I am indebted to Miss Agnes Creagh of the editorial staff of the Geological Society of America for her kindness in editing the manuscript.

more dependent on imports. Our interest centers on imports not only for economic reasons but also for political and military reasons. A great many of our raw-materials are imported for the purely economic benefits of importation even though they could be produced within our boundaries. Often a very modest change in the cost differential is the only incentive that is necessary—a fact that makes the protective tariff so inviting to self-sufficiency advocates. But mineral raw-materials, with few exceptions such as the zeolites, are not produced industrially, and many of them are of value as the ultimate sources of the elements. Under these circumstances the sources of mineral raw-materials take on added interest and touch the welfare of all of us. Their political control and political exploitation have become major items of domestic and foreign policy. The details of these policies are of intimate interest not only to the society of American (or other) people but also to the individual citizen—though he may not recognize it.

It is not my purpose to review the facts of mineral distribution, which are well known to the profession except insofar as military necessity still prevents the publication of later details. The excellent government sources of statistical information will, we hope, be published up to date before long. Nor is my prime purpose to offer a different interpretation or emphasis on these statistics. Many highly competent interpretative studies are available although there is no essential agreement within any major group—technical or political—on the proper policy to adopt. Other interpretations are still so welcome that I am reminded of Berenson's prayer: "Give us this day our daily idea and forgive us what we thought yesterday." My purpose is to stress to mineralogists our almost unrecognized obligation to pass on to our fellow Americans the information we have which is our special heritage. We are peculiarly well fitted by background, training, and experience to understand, to interpret and to teach the critical facts. More than any other professional group, ours should assume the responsibility, but I have been unable to find even one major contribution in the American literature to this subject by a professional mineralogist. Surely no other phase of the study of minerals is more important to the national welfare; nor is any of greater interest to those around us. Nor, for that matter, is the field of study being neglected. There are, however, many highly technical but most important details hidden in the sacrosanct recesses of our technical literature, which can properly be evaluated and stressed by mineralogists and which are waiting for the spotlight to be turned their way. For example, the dramatic emphasis which war has thrown on the quartz crystal led to the study by Parrish and Gordon, giving information without which a purely statistical picture is incomplete. And, similarly, a statistical statement of

the world's critical tin distribution gives only a part of the story. No statement of Bolivian tin reserves or production of concentrates has full meaning in terms of the economy of tin without a statement of the complex mineralogy of the Bolivian tin ores. The ease of smelting of Straits tin places a most severe handicap on a Bolivian ore competitor as is fully reflected in the past history of tin production. Only as a war measure has the United States been able to construct its own tin smelter.

During the past few months we have heard much about American foreign policy. Loud has been the cry for an implemented foreign policy especially with regard to our mineral needs and the available supplies. Perhaps no single phase of the discussion has stirred up more intense public interest than has that part of the Atlantic Charter which offered a hope of a fair solution to the raw-materials problem. I quote the pertinent clause, number four, from the Charter: "They will endeavor, with due respect for their existing obligations, to further the enjoyment by all States, great or small, victor or vanquished, of access, on equal terms, to the trade and to the raw materials of the world which are needed for their economic prosperity." This most important declaration carries great significance and promises much for the future welfare of the less-favored nations. It, together with other clauses in the charter, implies an end to this phase of economic imperialism with its concomitant selective exploitation of the world's natural resources. Immediately following the publication of the Charter public comment was highly favorable. With time, however, less-favorable comment developed and focused heavily on the difficulty of implementing clause four. Careful analysis of clause four does, I believe, lead inevitably to serious questions on the feasibility of executing its provisions. On at least two occasions Prime Minister Churchill has made public statements that have been interpreted as a wish to modify somewhat the full meaning of clause four. And recently President Roosevelt has denied the existence of a formal charter. The Charter will not easily be erased from the minds of peace-loving men. I am not now raising the question of right or wrong as applied to "the enjoyment by all States . . . of access . . . to the raw-materials of the world." I am recognizing along with others the great need for public enlightenment on these most vital facts—specifically the detailed dissemination of factual information on raw-material sources. American history indicates that the American people, once given the facts, usually have the knack of arriving at a sound conclusion. But sound or unsound, it is their inalienable right both to have the facts and to look to us for them. From such public education will arise the impetus toward a logical American raw-materials foreign policy.

Hugh Gibson, one-time ambassador to Belgium and to Brazil, recently

said on a closely related subject: "If we are to have peace and order it must be on the basis of long range planning among the principal powers. We stand alone among the great powers as a nation that can never plan more than four years ahead. . . .

"The people should be informed as to policy, not as to current negotiations, but as to aims and purposes. Without full information they cannot exercise the intelligent control of government, and our representatives will continue at the mercy of shifts of feeling.

"Shifts in public opinion inspired by emotional rather than accurate knowledge are responsible for many changes in our foreign policy."

These remarks of Mr. Gibson were intended for a wider coverage than mineral raw-materials. They are nevertheless in point.

Between peace times and war, the difference in a state's need for the access to raw-materials is mainly one of degree. The need was fully and readily recognized by Britain and the United States when the Combined Raw Materials Board was conceived in December 1941 as a war measure. It was implemented by lend-lease, doubtless both ways. It was intended that it should solve the main war-time raw-materials problems among the Allies. Its very existence is recognition of the need for the implementation of clause four, even between two countries traditionally close economically. I join those who believe that the length of the next period between wars will depend largely on the degree to which this now famous clause four is crystallized. The Combined Raw Materials Board reflects a will to international co-operation, recognized as essential during war. But an analogous willing co-operation is also essential to a lasting peace. Only by some such co-operation can the raw-materials problem be solved. Its solution is receiving growing recognition as a prerequisite to the peace we hope for.

A few selected mineral raw-materials present such a complex post-war aspect to the major powers that they are receiving immediate attention. America appears to be the main activating agent in the steps so far taken. How far toward a solution our efforts will or can go may be a barometer for other similar mineral questions. I shall illustrate by quoting a United Press report of July 14, 1944: "The forthcoming American-British oil conference will seek agreement on an American plan to establish a world oil accord, open to all nations and based on the Atlantic Charter principle of 'access on equal terms to the raw-materials of the world,' . . .

"The purpose of the accord if it is joined by all producing as well as consuming countries will be to create a world commission to recommend allocation of world petroleum on the basis of need rather than on the past basis of ability to pay." A tentative agreement has since been reached and

is in a sense a controlled cartel, somewhat similar to the pre-war rubber and tin agreements. It resembles too the interstate Oil Compact. At the time of this writing it is to be reworded to facilitate interpretation.

In the past we have depended on free trade as a means of "freedom of access to the raw-materials." An extensive literature explains why free trade has failed to satisfy the various national demands for a suitable living standard, but literally reaches no agreement on an alternative method of international distribution. Whatever means is adopted for raw-materials distribution must first stem from action by the governments of the participating nations and thus become an item of paramount importance in the foreign policy of each interested party. But we cannot stress too heavily that these foreign policies must be understood and approved by the people which those governments represent, in a truly democratic way. Failing in these respects the structure cannot stand. The consequences of its fall are now well known to us. R. L. Buell has expressed this thought in more general terms: "An enduring cooperation among nations must arise out of enlightened *public opinion* and intercourse between peoples." And again he says, "The future of the world must rest primarily upon government action and policy arising out of a vigorous and intelligent *public opinion*." (The italics are mine.) Here again, may I repeat, the mineralogist as a specialist in the most critical and strategic of raw-materials has both a privilege and an obligation to serve as few can serve.

One of the foremost problems confronting the post-war planners is that of monopolies and cartels. The history of the tin cartel has been well publicized. Some of the indirect effects of the operation of this cartel are known to us from everyday war-time experience. During the war when the oriental sources of tin have been cut off we have drawn heavily on the relatively newly developed tin deposits of the Belgian Congo. Although the details of Congo reserves and production have been officially withheld in the interest of national security, yet it is rather generally understood that these deposits are to play a prominent part in the future international economy of tin. Since Bolivian tin has been proved quite incapable of offering serious competition to the well-established British position in tin production and smelting, we find international interest focusing on such a potential competitor in the picture. A brief item in the New York Times early in 1943 quotes the London Daily Mail to the effect that Belgium may merge with the British Empire after the war, Belgium to receive thereby greater British protection. This possible union was spotlighted in the public eye by the Saturday Evening Post, December 30, 1944. Should such an event be within the realm of future possibility it is easy to conceive of the benefits to accrue to Belgium. It is

also relatively evident that Britain too would benefit from the resultant political control of the natural resources of the pre-war Belgian sphere of influence—I have in mind especially the diamond, copper, and tin deposits of Belgian Africa. If the British tin supremacy is thus to continue, what is the effect on the United States and its infant tin-smelter industry? Has the United States been able to obtain assurance of sufficient tin concentrates from the Belgian Congo to keep our newly constructed, war-time tin smelter operating after the war to satisfy a part, or all, of our tin needs?

There is much American support for the principle of monopoly and freedom of competition. Alfred Sloan, Chairman of General Motors, said in June 1944: "My own point of view is that cartels should be outlawed under all circumstances, domestic or overseas. I believe we will do better here and progress in the world generally . . . will be accelerated if competition prevails wherever business enterprise is operated."

On the other hand opposing views within our own borders hold the cartel principle as fundamental to efficient production and prerequisite to fair marketing. I select the recent remarks (January 5, 1945) of C. M. Micou before the Trade and Commerce Bar Association to express this viewpoint. Quoting from the press report: "While the international cartel issue lends itself peculiarly to the 'emotional approach,' the complicated subject is 'as susceptible to solution as any other of our numerous international economic problems.' Many of the abuses, which have been recently exposed, he said, have been revealed as abuses in the light of subsequent events. Blame, he added, has been placed on business men for the same lack of vision and failure to see the coalition of evil forces as characterized 'our national administration.'

"Although 'classic cases' yet must be proven or appraised by the courts 'in their true context,' the Department of Justice has used publicity 'in a policy of *in terrorem* enforcement.' Unless the courts or Congress intervene, he continued, dire consequences may be expected for the country's foreign trade.

"There are many exceptions to the ideal of free competition in the United States, he pointed out, citing agricultural marketing agreements, labor combinations, carriers and the Miller-Tydings Amendment limiting competition as to prices. At the same time, in foreign trade many countries encourage and some require agreements among competitive producers assuring orderly production and marketing."

Such highly important questions must become items of public concern in the planning of American foreign policy. Our elected representatives are divided in their opinions but the office of the Attorney General is adopting an anti-cartel policy. Such momentous decisions should receive

their inception from Americans such as we, but too many Americans don't know the meaning of the term "cartel," much less its possible impact on the national life. And until they do, and until they express their convictions through their representatives, our official attitude is confused. In June 1944 the New York Times editorialized as follows: "A Washington dispatch to this newspaper reports that a program for post-war handling of cartels has been recommended by technical experts of government departments. This program calls for an international agreement pledging nations to an anti-cartel policy, which, however, would recognize that international commercial agreements can serve other than restrictive purposes. The proposed agreement would include a provision for an international repository where agreements of the kind customarily made by cartels would be filed. This would be an attempt to apply the 'disclosure method' of regulation adopted in the Securities Act. . . .

"These proposals indicate somewhat more realistic thinking on the subject of cartels than has come out of Washington heretofore. They raise the question, however, whether we should not try to clarify our own minds on the subject much further before making international proposals of this sort. . . .

"The best way for the government to clarify its own ideas would be to appoint a commission of first rate economists without special axes to grind to reexamine the question of monopoly and competition, both in the domestic and in the international field, with regard to government policy. Not until this nation's own mind is reasonably clarified as to what our policy ought to be will it be profitable to frame specific proposals to present to other nations."

In part our motive must be a selfish one—to fulfill the requirements of the American standard of living. But we have grown greatly in our realization of the part we must play in sharing the responsibilities of the world community of nations. Wendell Willkie said in his proposed platform draft: "We know from bitter experience that the United States cannot survive militarily, politically, or economically in the modern world without close and continuing cooperation with other peace-loving nations." And from the Republican platform of 1944: "The United States must be prepared to undertake new obligations and responsibilities in the community of nations. We must cooperate with other nations to promote the wider international exchange of goods and services."

In a comparatively recent national poll 62 per cent of the American people expressed the opinion that this war is not to be the last. Is that merely a fatalistic acceptance of man's inability to get along with man? Or is it a lack of our confidence in the peace makers to see beyond their national boundaries? To win a peace is admittedly difficult.

Can we, should we, found the peace on an honest attempt at an equitable adjustment of the world's right to a fair standard of living when Germany's Goebbels can say publicly to German workers in July 1944 that the German Reich "will not have a chance to repeat this struggle for another 10, 20 or 50 years if it loses the present war." Man, being what he is, will sometimes improve his living by illegal methods if the power behind the law will permit. Are nations of men different from the men who compose them, and will they accept their fair share peacefully and without protest even though there is no enforcing power behind the allotment? Nations never have. Must we not agree with Lord Lothian that peace depends on overwhelming power behind just law? The power is now ours. The just law is still to be formulated. It awaits the crystallization of public opinion.

Americans characteristically recoil from the exercise of power—even from the display of power—as a means of maintaining peaceful relations with their neighbors. The facetious comment has been made that we prefer the policy of purchasing friendship. Suggestions alternative to the exercise of power have arisen, aimed at circumventing the need for a power-sustained peace. One of the more recent of such suggestions is that of Walter Lippmann, who proposes that the world may be divided into orbits of a sort of international communal interest. This proposal presupposes that such orbital areas are either self-sufficient or may be supplemented by mutual trade. But official statistics show that there are no self-sufficient areas. Mineral shortages transgress such areas and may be overcome only by normal trade as we understand it. The failure of such trade—as it has always failed—affects national living standards downwards. As long as the raw-materials necessary to modern living are denied to major parts of the world's populations, the ultimate sources of wars remain. My fundamental premise is that the depression of living standards through raw-material shortages is a prime cause of war.

Enlightened public opinion has been suggested as a most potent force toward permanent peace. Intelligent, responsible, and popularly supported government by the major powers is the first requisite. Raymond Clapper said pertinently: "Never overestimate the peoples' knowledge, nor underestimate their intelligence." And from the pen of Sumner Wells, relative to the Nazi control of public opinion through control of the press: "When this war is over the peoples of the earth must never again permit a situation to arise where any people shall be deprived of their inherent right to know the truth." The truth, properly taught, robs the aggressor of his momentum. But especially it places the non-aggressor on his guard. We must interest the average American in the most sensitive of all the barometers of war—mineral raw-materials shipments. The

problem is difficult, but peace is difficult. Complacent relaxation following war is the characteristic reaction of a democratic victor. It is the drop in the guard which in peace invites the retaliatory counter move on the part of the vanquished. Not even the United States—a most favored nation—could enter upon a war without stockpiling. And such stockpiling cannot be done in secrecy in any country. A public awareness of the meaning of such stockpiling could, some think, prevent the aggression.

An ingenious scheme has been proposed by Dr. C. K. Leith whereby the peace shall be maintained by withholding from the aggressor nations, because they are aggressor nations, the mineral materials which they need for military aggression. H. G. Moulton and L. Marlio oppose the method on grounds of practical execution. For a time at least, possibly even for one generation, we might expect such a plan to succeed. But no matter how regarded, it is peace by the bludgeon. It is protection from the aggressor by being more aggressive than he, or at least more successfully aggressive. In other words, it is another plug to the same old world volcano. It is power-sustained peace and carries all the evils of such a peace. It is suppression and intimidation of the vanquished—be good or we'll cut off your supplies—whereas at least one of our war aims is human freedom and equality of access. It is of course better than no solution at all in that it offers temporary quiet, but it is far from air tight. National aspirations are irrepressible, and will lead any rationed nation to misappropriate for military needs a part of its allotted raw-materials, thereby creating a civilian scarcity. Such scarcity, translated into a lowered standard of living, has long been an adequate cause of war.

This statement is not intended to deny that the next international peace must be maintained by an adequate force just as is domestic peace. But the power used, to be effective without causing reverberations, must be one that plucks the fangs without otherwise harming the well being of a defeated nation—it must not lead to the deprivation of the citizenry, to a lowered living standard.

A pre-eminent proposal, though not a very new one, suggests a super-state—international power to supervise the peace. It is of course a league of nations in a new cloak. Its greatest strength lies in its freedom from interference with world trade—in fact, if it functions as the league did it will actually promote international trade. It recognizes the interdependence of the several peoples of the world. It will stimulate collaboration and help to integrate our economic life with that of other countries.

Henry R. Luce has said: "We Americans must first of all come to some basic agreements among ourselves as to what, concretely, we are prepared

to do and to undertake. Our discussions must be frank and free. They will, to be sure, be overheard by all the world. And some of us sometimes may give offense to other peoples. But the worst offense which we could commit against the rest of mankind would be to arrive at victory without any common conviction among ourselves as to a program to which we would be willing to dedicate the power and influence of our nation."

Whatever the chosen solution, it is of paramount importance that it meet with popular approval, not alone with the approval of our leaders. It must be a central principle of our foreign policy and must be concerned heavily with the exchange of raw-materials without which no nation can thrive as each has a right to thrive. But popular approval can come only through extensive public enlightenment. Our duty is clear, our responsibility is well defined. The few who have pioneered so well and so far cannot alone complete the task. It is a mineralogist's obligation.

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TUNGSTEN DEPOSIT NEAR TOWNSVILLE, NORTH CAROLINA

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Abstract

The tungsten deposit near Townsville is in an area which heretofore has not been known to be mineralized. The dominant ore mineral is huebnerite which occurs in a quartz vein containing much fluorite and sericite as well as small quantities of rhodochrosite, sulfides and other accessory minerals. Scheelite also forms an important constituent of the ore and is believed to result from the hydrothermal alteration of huebnerite although superficially its appearance suggests supergene origin.

Location

The recent discovery of economically significant tungsten deposits in Vance County, N. C., represents not only the development of a mineral industry new to the southeast, but also the discovery of economic mineralization in a locality where it had never been observed before. The deposit was discovered by Mr. Joseph Hamme of Oxford, North Carolina, and Mr. Richard H. Hamme of Virgilina, Virginia. The principal mineralized area is a little less than a mile long and a few hundred yards wide. It is located near the northwest corner of Vance County a short distance south of the Virginia State boundary and about three miles west of Townsville, North Carolina. It lies between Big Island Creek and Little Island Creek about a mile south of their confluence on properties now controlled by the Haile Mines Company. Less intense mineralization can be traced for several miles to the north and south but apparently the only other important locality is on the Thomas A. Morgan property about two miles south of the Haile Mines location.

Description of Area

The general location is in a part of the lower Piedmont about 50 miles from the inland edge of the Coastal Plain in an area which has been rather well peneplaned. However, the principal tungsten deposit is located on the topographically mature interfluve between Big Island and Little Island Creeks which are dissecting the peneplane, and consequently the area immediately surrounding the deposit has rather sharp relief. The general altitude of the peneplane is about 400 feet whereas the flood planes of graded streams have an altitude of about 260 feet making approximately 150 feet of local relief.

The country is covered by the typical mantle of residual soil which is characteristic of the southeastern Piedmont. Very few outcrops of fresh

rock are found save for artificial openings such as an old railroad cut at the north end of the area and certain large gabbro dikes which sometimes stand out as stony ridges or boulder trains. However, the drainage is largely subsequent and affords a fair index to geologic structure. The larger streams such as Big Island Creek, to the northwest of the area, and Little Island Creek to the east have rather well developed flood plains, which are occasionally interrupted by gorge sections where the streams traverse more resistant rocks. Little Island Creek in particular seems to follow the regional strike of the schistosity. The smaller valleys seem to adhere to a rectilinear pattern enforced upon them by the two major directions of structural weakness which are the previously mentioned regional strike (about N. 10° E.) and a series of transverse shears which strike generally about N. 70° W. and frequently show considerable displacement. These two structural directions are also manifest in the orientation of the tungsten bearing veins which, in most instances, have been emplaced parallel to the schistosity but occasionally occupy the transverse shears.

Description of Rocks

Geologically, the area is located on the contact between Carboniferous granite, which appears in rather large mass to the east, and an area of metamorphic rocks to the west. On the regional maps the latter have been shown as part of the volcanics and slates of the "Carolina Slate Belt," but in the immediate area of the veins there is little evidence to suggest that the rocks belong to that less metamorphosed complex. In this paper they have been referred to the Wissahickon correlatives which have long been recognized a little farther east in Warren and southeastern Vance Counties. In the principal mineralized area the wall rocks are dominantly light colored sericite schists intimately associated with bluish gray gneissic rocks that contain much opalescent quartz which appears as clear blue grains in the hand specimen. The origin of this latter, gneissic rock is somewhat obscure. On the maps of the U. S. Geological Survey[1] it has been included with the granite, but to the writer it appears to be an altered phase of the schist, with which it is associated. Its only fresh exposure is found in the old railroad cut toward the north of the area. However, the most characteristic type of float throughout the area underlain by schist is an iron-stained, highly siliceous rock bearing large grains of blue quartz which closely resemble those found in the gneiss. For this reason it is believed that the gneiss is an altered phase of the schist which probably appears rather commonly near the zone of contact with the

[1] Tungsten Deposits in Vance County, North Carolina and Mecklenburg Co., Virginia Strategic Minerals Investigations Preliminary Map.

granite and in particular near hydrothermal veins. There is little doubt that it was produced by mobile emanations from the granite.

Under the microscope the opalescent quartz resolves to large grains of clear unstrained quartz which are surrounded by finer grained quartz aggregates that apparently are of later origin and have a mosaic-like appearance between crossed nicols. These two generations of quartz are also found in the veins as described below. This rock also contains plagioclase, apparently oligoclase, and an appreciable amount of epidote. Other minerals include magnetite in small euhedral grains, occasional small remnants of hornblende which have been largely resorbed and a little chlorite, calcite, and biotite. Rarely a minute grain of zircon is seen and near the veins pyrite and apatite appear. From microscopic studies of the veins and the wall rocks it is apparent that the mineralizing solutions deposited much quartz during the earlier phases of the period of mineralization and during the later phases deposited much sericite. For this reason in the vicinity of the veins the walls have been highly impregnated with quartz and sericite with the zones of dominant silicification occupying positions farthest from the veins and the zones of dominant sericitization appearing immediately adjacent to the veins.

Along the eastern side of the area, granite forms the country rock. Slightly more generous in fresh outcrop than the above described metamorphic rocks, it is a clearly igneous rock of uniformly coarse texture and shows little evidence of alteration. The probable contributor of most of the metasomatic alteration undergone by the older rocks of the area, the granite in turn has been affected very little by subsequent igneous activity. Rare secondary constituents such as epidote, calcite, and chlorite attest some slight alteration but as a rule comprise an insignificant part of the rock. The large Triassic gabbro dikes described below cut the granite without any megascopically visible effect at the contact.

Under the microscope the granite is seen to contain microcline and plagioclase, apparently albite. There is a fair amount of quartz and the mafic minerals are biotite and hornblende. Hornblende appears only as occasional reticulate remnants of grains which have been largely resorbed by quartz. Accessory minerals include occasional small grains of magnetite and zircon.

The gabbro and basalt dikes of Triassic age which are of common occurrence throughout the North Carolina Piedmont put in a significant appearance in this area. Two large gabbro dikes cut the mineralized zone near its center. One of these attains a width greater than 300 feet. Several smaller dikes, manifest by occasional pieces of float, cannot be traced with any continuity. Probably most of these occur as impersistent lenses when they appear in the schist.

In the hand specimen these rocks are very dark colored; in most instances almost black. However, in thin section they are seen to comprise two dominant constituents; colorless augite and labradorite. Magnetite which sometimes appears in graphic growths is the only primary accessory, although there is a little secondary chlorite and calcite.

In connection with the Triassic dikes it is of interest to note that nearly every natural exposure of granite in the area studied was observed to be closely alongside one of them. Apparently the dike rocks had some inconspicuous contact-metamorphic effect upon the granite host rock rendering it slightly more resistant than the general mass.

In addition to the Triassic gabbro, dikes of an older basic rock appear along the eastern border of the mineralized area. In this rock the effects of alteration have been so differential that no two outcrops are alike although the megascopic appearance is usually that of a dark, greenish holocrystalline rock. Under the microscope most specimens resolve largely to epidote, chlorite, and quartz without clue to primary character, although some of the darker specimens are largely amphibole, apparently produced by uralitization of pyroxene. Occasional ghost structures suggest the former presence of feldspars. Laney[2] writing of the Virgilina District, about 20 miles to the west, describes gabbro dikes which cut the carboniferous granite and are older than the Triassic intrusives. These he says have been much altered and are of variable character in their present form. It is probable that the older basic rock of the Townsville area is the same as this altered gabbro of Laney.

Closely parallel with the older basic dikes just described are a number of small light colored dikes which resemble rhyolite in the hand specimen and occasionally display flow structures. Under the microscope these are seen to be almost wholly composed of secondary minerals such as quartz, chlorite, and zoisite. Rarely a small remnant of hornblende is seen and occasional large ghost structures suggest former feldspar phenocrysts.

Structure

As noted above, the region seems to have undergone considerable stress in the period following the granite intrusion. A series of small shears and faults were developed which are usually nearly transverse to the regional strike, their mean orientation being about N. 70° W. They are not easily discerned on the ground, but are frequently reflected in topographic development and their influence on cultural boundaries has made them quite manifest in the aerial photograph. Some of the faults

[2] Laney, F. B., The geology and ore deposits of the Virgilina District of Virginia and North Carolina: *N. C. Geological and Economic Survey, Bull.* **26**, 58 (1917). Also, The Gold Hill Mining District of North Carolina: *N. C. Geologic Survey, Bull.* **21**, 73–74 (1910).

are much more prominently displayed than others, as for instance one which passes along the northern edge of the principal mineralized area causing displacement in the channel of Big Island Creek and localizing the positions of three different ravines. Another notable topographic effect is a series of offsets given to the main ridge line which traverses the center of the mineralized area from the southwest to the northeast. Evidence of motion can also be found in the slickensided surfaces which occasionally appear on the walls of the cross veins in prospect pits. These may also be found on the walls of certain of the veins which follow the schistosity of the country rock suggesting that there has also been some motion in the plane of the strike.

These faults antedate the emplacement of the tungsten-bearing veins and some few of them are occupied by veins. In general, however, the faults do not appear to have had any important effect in delimiting the veins, probably because the mobile solutions could pass with considerable freedom through the schistose wall rock. The faults seem to have been still active to some extent at the time of mineralization.

An interesting feature of the cross faults is the fact that they frequently bring about displacement of the post-fault Triassic dikes. The dikes are offset by the faults, but in a rather unusual manner. From the offset segments there are appendages which persist across the fault plane. From such relationships it is inferred that the dikes are post-fault intrusions which found their most ready avenues of movement in the weaker zones of the schist which were largely oriented parallel with the plane of the schistosity. In such a zone of weakness a dike would keep a fairly straight course until it encountered a fault. There it would find that the particular zone of weakness which it had been following had been truncated. Accordingly it would occupy the fault plane until the same zone of weakness was again encountered or a similar one was found. Frequently, abortive attempts were made to follow inadequate openings which the faults had chanced to throw opposite the major ones which the dikes had been following. Such attempts have produced the occasional appendages to the truncated segments of the dikes. In many instances adequate openings in the schist were apparently so plentiful that the dikes were enabled to cross the faults without appreciable offset.

Age Relations

The geologic history of the area is not fully revealed by the structural relations observed. The principal barrier to a fuller knowledge lies in the fact that there are very few outcrops and that most of those available are small. In general, however, the sequence of events seems to be as follows. Apparently, in Carboniferous time, the schists which are of pre-

Cambrian origin were intruded by granite. After the granite cooled, the older gabbro and the rhyolite which were probably later differentiates of the same magma were injected into the complex in the form of dikes. Following this the area was subjected to dynamic stress and the series of east-west shears were developed. Apparently there were also some shears developed parallel to the plane of schistosity. It was probably during the later part of this period of strain that the hydrothermal solutions appeared and the veins were emplaced. At the same time much silicification, sericitization, and propylitization took place in the more accessible rocks; the schist especially and to a lesser extent in the older gabbro and the rhyolite. Later, in Triassic time, the region was again intruded by gabbro dikes, which are the youngest rock found.

Description of Veins

The veins seem to be limited largely to those parts of the area underlain by schists. The hydrothermal solutions are believed to have had their origin in the Carboniferous granites, although, here, as generally throughout the region, there is little evidence of hydrothermal bodies in the granite itself. In general the principal area of mineralization is in the schist a short distance to the west of its contact with the granite.

Although the mineralized zones are not quite at this contact, they are near enough to it to suggest strongly that their localization has been influenced by it. With few exceptions the tungsten bearing veins were emplaced in fissures which paralleled the plane of contact, although this may very well have been mere coincidence, because both veins and contact plane follow the direction of schistosity.

Silicification of the country rock adjacent to the veins has caused the mineralized zone to stand out as a prominent topographic ridge which forms the divide between Big Island and Little Island Creeks. Many of the veins are of exceptional thickness, some reaching 30 feet, but they usually do not persist more than a few hundred yards along the strike. The vein matter is dominantly quartz with much fluorite interbanded in long interfingering lenses. The chief ore mineral is huebnerite but considerable scheelite is associated with it. The period of mineralization appears to have begun with the entrance of silica laden water in large volume which passed quite generally through a wide zone of the schist near its contact with the granite. The arterial fissures were filled to form the large lenticular veins, and at the same time the schist itself was densely impregnated with secondary quartz to form the gneissic rock described above. The quartz deposited during the earlier stages of this period of silicification, both in the veins and in the wall rocks, is char-

acterized by a much coarser grain than that which was deposited during the later stages of the period. This difference in grain size makes it rather easy to distinguish the early from the late quartz in thin section. The contact between the two is usually not a sharply demarked line but none the less the later, finer-grained variety usually appears in small tongues, veinlets and lenses which cut the coarser variety and suggest that they were emplaced after a period of renewed clastic movement had brecciated it. An example of this relationship is shown in Fig. 1. Between the end of the period of deposition of the coarse quartz and the beginning of the period of deposition of the fine there may have been a quiescent interval

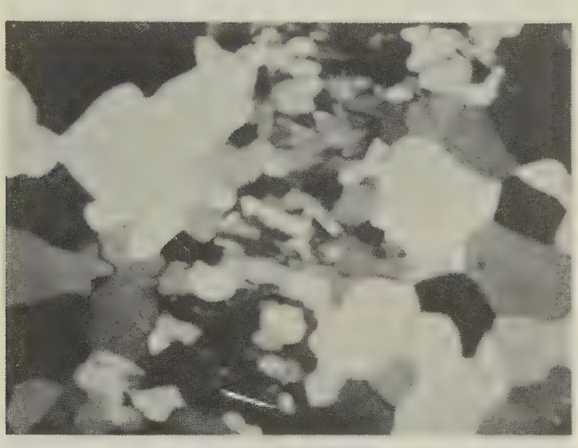

FIG. 1. Small tongue of fine quartz cutting coarse quartz, sericite lath in fine quartz; crossed nicols, ×45.

during which no quartz was deposited, but this seems rather doubtful. More probably the deposition of quartz was continuous but of varying intensity.

As suggested in the diagram shown in Fig. 2, huebnerite was the first ore mineral to appear. Apparently it replaced the coarse or early quartz by euhedral crystalline growth. However, almost without exception these original euhedra were fractured and dismembered by clastic movement which seems to have antedated that which created the openings in which the later, finer-grained quartz was deposited. This is demonstrated by the fact that there is no distinction in grain size between the early quartz of the general ground mass and that which filled the openings between the displaced fragments of the broken huebnerite crystals, as can be seen in Figs. 3 and 4.

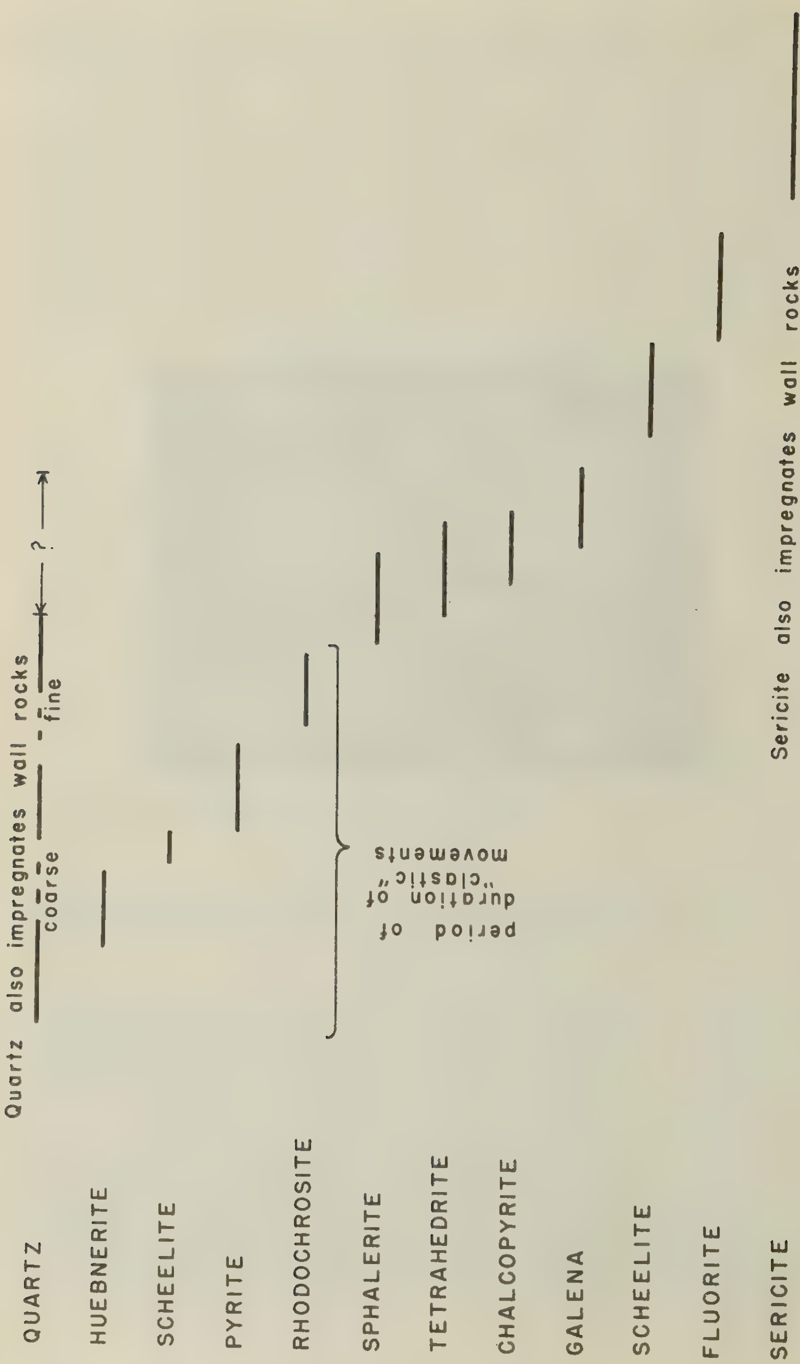

FIG. 2. Diagram showing apparent paragenesis of minerals in veins.

That the dismemberment of the huebnerite crystals is, in most instances, the result of brecciation rather than replacement can be demonstrated from thin sections by the juxtaposition of original structures in

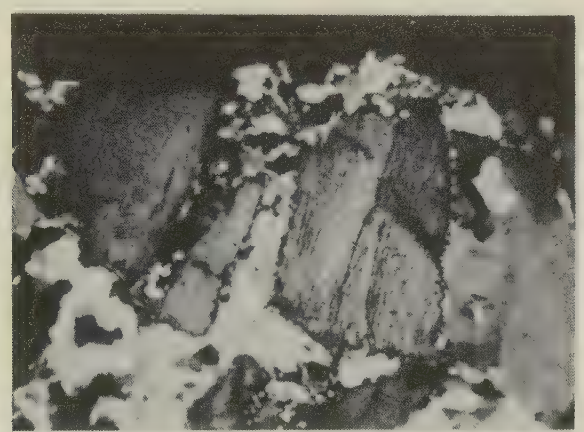

FIG. 3. Fractured huebnerite crystal showing displacement of the several fragments and filling of the fractures by coarse-grained quartz. Laths of sericite replace the quartz filling, and narrow rims of scheelite surround the fragments of huebnerite. Crossed nicols, ×34.

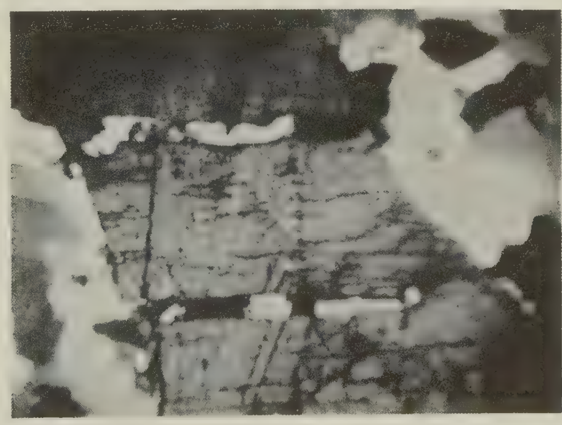

FIG. 4. Fractured huebnerite crystal similar to that shown in Fig. 3. Displacement of fragments is manifest in juxtaposition of severed microstructures; fractures are filled with coarse, early quartz. Crossed nicols, ×34.

the dismembered fragments. Figure 5, for example, shows a zoned huebnerite crystal, in which it can be seen that the boundaries between the color zones in the two displaced segments would match if the segments were brought together again. In Fig. 3 it can be seen that, of the

three fragments of the large dismembered huebnerite grain shown, the central fragment has been displaced out of line with the ones on either side of it. Again, in Fig. 4, movement of the dismembered fragments of huebnerite can be inferred from the lateral displacement of microstructures on opposite sides of the quartz filled fractures.

FIG. 5. Dismembered huebnerite crystal showing zonal growth. Evidence of displacement can be seen in the matching color zones on opposite sides of the fracture. The fracture is filled with early quartz. A fine reaction rim of scheelite appears at the edge of the huebnerite on both sides of the opening. ×34.

Apparently a small amount of primary scheelite was deposited at the same time as the huebnerite when the hydrothermal solutions were carrying tungsten. This seems evident from the appearance of occasional large crystals of scheelite which have been replaced by pyrite euhedra. However, the bulk of the scheelite is apparently an alteration product of the huebnerite and was formed at a later period when the solutions were carrying calcium but probably no tungsten.

Pyrite appears to have been the next mineral to form after huebnerite. However, it does not seem to have been emplaced until after the huebnerite had been fractured and the openings filled with quartz, for there has been no fracturing or dismembering of the pyrite nor has it been observed as filling between the dismembered fragments of huebnerite. On the other hand, it does sometimes replace huebnerite, usually presenting smooth rounded contacts to both the huebnerite and the enclosing quartz gangue. Sometimes the pyrite itself is in turn replaced by the later fine grained quartz which tends to invade it with irregular reentrants. It thus appears that the pyrite antedated at least part of the fine quartz, but probably

was not emplaced until after deposition of coarse quartz had stopped.

Rhodochrosite seems to have entered the veins after the pyrite was deposited. In the sections in which it has been observed, it cuts through an intimate association of quartz, huebnerite and pyrite, but both the rhodochrosite and this assemblage of earlier minerals are replaced by veinlets of fine quartz which carry the later sulfides, chalcopyrite, tetrahedrite, and galena. The rhodochrosite is replaced intimately along the cleavage planes by this late quartz.

The later sulfides, sphalerite, tetrahedrite, chalcopyrite, and galena, were apparently deposited generally in the order named, but with considerable overlap as shown by the paragenetic chart in Fig. 2. Probably the deposition of fine quartz continued to some extent throughout the period of their deposition, for they are all associated with it to a considerable extent. The tetrahedrite appears in intimate association with galena and sphalerite, and the chalcopyrite is usually seen in close association either with pyrite which it replaces or with galena which usually replaces it. From the relationship described in the preceding paragraph it can be shown that sphalerite, tetrahedrite, chalcopyrite and galena are later than rhodochrosite. In other sections sphalerite is seen to replace pyrite and to be replaced in turn by galena and chalcopyrite. As seen to date the sulfides do not form an important component of the ore.

Apparently near the end of the period of deposition of the sulfides the formation of the second generation of scheelite began. Most of it appears in close association with huebnerite although it has been observed in narrow peripheral zones on sphalerite and galena, and traversing the quartz gangue between these minerals. Despite this replacement of other minerals, the predominance of its intimate association with huebnerite has led the writer to conclude that it is largely a hydrothermal alteration product of that mineral. Since fluorite appeared in quantity about the same time as the scheelite it is evident that the solutions must have contained appreciable calcium at that time and there seems little reason to believe that they brought in any additional tungsten. This idea is supported by the fact that by far the commonest mode of occurrence for the scheelite is as narrow but continuous reaction rims on the surfaces of huebnerite crystals. A large percentage of the huebnerite crystals have such coatings of scheelite on their surfaces and traversing internal fractures. Examples may be seen in Figs. 3 and 5 where the scheelite coatings appear as narrow lacy bands with high relief at the very edge of the huebnerite fragments. The same relationship can be seen in Fig. 6 which is discussed below. Not infrequently the alteration process has progressed so far that large percentages of the huebnerite crystals have been changed to scheelite as illustrated in Figs. 7 and 8.

In many instances the manner of occurrence of the scheelite suggests that it might be a supergene alteration product but this possibility seems to be precluded by the fact that it is commonly replaced by sericite, as discussed below.

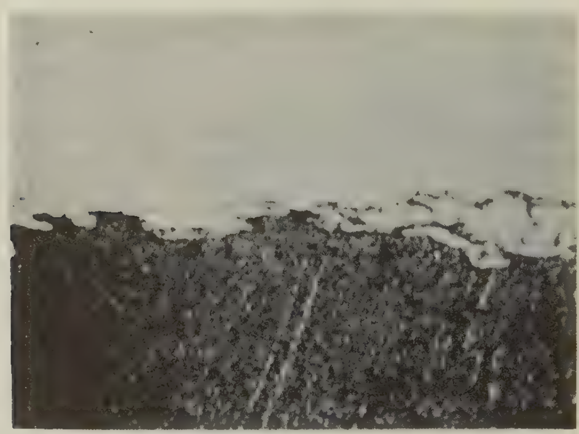

FIG. 6. Huebnerite (dark) and quartz (white) with scheelite and sericite along their contact. Scheelite replaces huebnerite and sericite replaces quartz and scheelite; ×45.

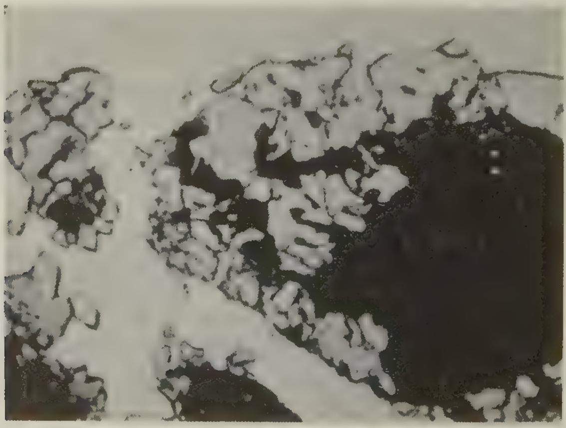

FIG. 7. Huebnerite (dark) replaced by scheelite. White ground mass is quartz; ×45.

The paragenetic position of fluorite is not wholly clear. It can be seen to be younger than sericite which commonly appears throughout it as euhedra, and it is apparently later than most of the quartz which also commonly appears within it, usually as small, isolated, grains and aggregates which have been rounded by resorption. Sulfides occasionally occur enclosed within the fluorite but they also appear to be partially-

resorbed inclusions. All of these relationships are shown by the photomicrograph in Fig. 9 which was taken with nicols at 45° in order that the opaque sulfides and the quartz and sericite might all be distinguished from the fluorite in the same photograph. The relationship between

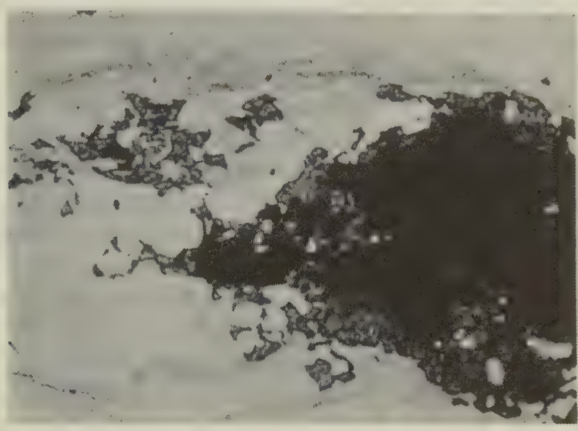

FIG. 8. Huebnerite (dark) replaced by scheelite (high relief). White ground mass is quartz. Laths of sericite (low relief) replace quartz and scheelite; ×45.

FIG. 9. Fluorite (gray ground mass) replacing sulfides (black) and quartz (white equidimensional areas). Sericite (white laths) cuts fluorite and sulfides; nicols at 45°; ×45.

fluorite and scheelite is not known, but since they both appeared after the late sulfides and both contain calcium it is probable that they were deposited at about the same time.

Sericite was the last mineral deposited. It is abundant in both wall rocks and vein matter and usually appears in wisps of commonly aligned

euhedra which traverse the earlier minerals in such clear cut manner as to make their late entry unequivocal. Evidence of this may be seen in the photomicrographs shown in Figs. 3, 6, 8, and 9. In Fig. 3 sericite can be seen replacing quartz between the dismembered fragments of huebnerite. In Fig. 6 it appears, along the contact between the huebnerite and the quartz, invading scheelite which had previously entered the same contact by replacing the huebnerite. It can be seen replacing scheelite and quartz in Fig. 8 and replacing fluorite in Fig. 9.

Apatite also appears in the vein but was not observed in the sections prepared for microscopic study. Therefore, its paragenetic position is not known. Its usual relationships elsewhere would suggest that it was deposited among the early minerals, but the fact that it contains calcium and possibly fluorine lends some credence to the idea that it might have been deposited about the same time as the scheelite and fluorite, toward the end of the period of mineralization. It is of interest to note that it has an orange fluorescence.

Secondary tungsten minerals frequently occur in the zone of leaching. Apparently the commonest of these is tungstite which appears as yellow films and scales.

To the south there is an area where there are many large quartz veins that carry small amounts of black tourmaline but are barren of tungsten minerals.

Two large huebnerite crystals from an outcrop in the northern part of the principal mineralized zone were analyzed for the purpose of mineral identification. It is probable, however, that small amounts of scheelite were included in the analysis. The results were as follows:[3]

WO_3	72.30	68.10
MnO_2	25.68	25.61
Fe_2O_3	2.45	1.40
	100.43	95.11

The writer is indebted to Dr. Paul F. Kerr of Columbia University who checked the identification of huebnerite, pyrite, sphalerite, rhodochrosite, galena and tetrahedrite by means of *x*-ray diffraction patterns.

The deposits have been drilled by the U. S. Bureau of Mines and many of the petrologic observations described here are based upon an examination of their cores.

The work from which this paper is derived was done under the direction of Dr. J. L. Stuckey, State Geologist of North Carolina. Whatever merit it may have is in large measure due to his counsel and assistance.

[3] Chemical analysis by Dr. W. A. Reid, Chemist, Division of Mineral Resources, Department of Conservation and Development, Raleigh, N. C.

PRESENTATION OF THE ROEBLING MEDAL OF THE MINERALOGICAL SOCIETY OF AMERICA TO EDWARD H. KRAUS

Walter F. Hunt,
University of Michigan, Ann Arbor, Michigan.

A special meeting of the Mineralogical Society of America at this particular time has a two-fold purpose: to commemorate the first quarter century of the founding of the Society and to carry out the instructions of the Council passed in December 1943 that this meeting should also be the occasion for the presentation of the Roebling medal. The two purposes mentioned are very intimately related as it will be noted that the recipient of the Roebling award this year, Dean Edward H. Kraus, was a member of the organization committee and as chairman was largely responsible for the founding of the Society twenty-five years ago. While it is not my intention to dwell at great length on the historical events that led to the establishment of the Society, a few remarks seem pertinent in connection with this presentation—the fifth award made by the Society.

While the question of the desirability of organizing a separate society composed of members interested mainly in mineralogy, crystallography and the allied sciences had been under consideration for a number of years, it was not until the Albany meeting of the Geological Society in 1916 that a small group of six decided to take some formal action. It was felt that the formation of a mineralogical society would stimulate greater interest in the subject and at the same time offer a ready outlet for the ever-increasing number of papers in this field through the establishment of a society journal. It was pointed out that with respect to organization and means of publication the mineralogists of America were not keeping pace with their colleagues in Europe and the time had arrived for the founding of a society whose standards, insofar as fellowship was concerned, should be equal to those of the Geological Society of America.

This small group of six consisted of Edward H. Kraus (Michigan), Alexander H. Phillips (Princeton), Frank R. van Horn (Case School of Applied Science), Thomas L. Walker (Toronto), Edgar T. Wherry (U. S. Bureau of Chemistry), and Herbert P. Whitlock (American Museum of Natural History). Dean Kraus was selected as the one "to conduct the correspondence looking toward the organization of the Society."

A circular letter was sent to a selected list of mineralogists in the United States and Canada to determine the consensus of opinion with regard to the formation of a new society. It was then planned to com-

plete the organization as quickly as possible if the returns showed a sufficient number of favorable replies. On February 5, 1917, such a letter was addressed to fifty-one mineralogists, inviting them to unite as charter members in this new organization to be known as the Mineralogical Society of America. By October 12, 1917, the replies indicated that thirty-five were in favor of such an organization. But on account of the very unsettled conditions then existing, due to the war, it was thought wise to take no immediate action at that time. However, by December, 1919 it was believed that the time had arrived for taking the final steps. An organization meeting was called for December 30, 1919, and an invitational letter to attend was sent to all who might be interested. It thus came to pass that at a meeting in connection with the thirty-second annual gathering of the Geological Society of America a group of twenty-eight mineralogists from all parts of the United States, including representatives from Canada, met in the Mineralogical Museum of Harvard University and organized a new society. At this meeting a provisional constitution and by-laws were adopted and negotiations started for affiliation with the Geological Society of America which were successfully concluded the following year.

It is very significant to note that the first President of the newly formed society was Dean Kraus, a signal honor to the leader of this small group of six and formal recognition by the Society that the immediate goal of the organization committee had been achieved. The hopes and expectations of the founders have I am sure been fully justified by actual accomplishments during the first twenty-five years, both as regards total membership in the Society and the number and type of papers published in the Society's journal *The American Mineralogist.*

In the life and activities of some men it may be observed that after having attained a desired objective their ardor decreases and interest wanes. Dean Kraus' interest in and activity for the welfare of the Society has continued unabated throughout the years. It was his suggestion made at the tenth annual meeting that it would be very helpful if the Society had the means to establish awards for research and noteworthy achievements in the field of mineralogy that led to the establishment of the Roebling medal in 1930. As chairman of the Roebling Medal Committee he materially assisted the designer in the selection and arrangement of the proper symbolic emblems engraved on the medal. In recognition of this service he was asked by Dr. Bowen, then President of the Society, to deliver the presentation address when the Council voted the first award to Professor Charles Palache in December 1937.

Edward H. Kraus was born in Syracuse, New York, in 1875 and re-

ceived his early education in the schools and University of that city —B.S. in 1896 and M.S. in 1897. His alma mater on two occasions has paid tribute to his leadership in the fields of science and education through the granting of two honorary degrees, Doctor of Science in 1920 and Doctor of Laws in 1934. Shortly after completing his studies at Syracuse University he spent two years in Professor Paul Groth's laboratory at the University of Munich, Germany. Here he pursued more advanced work in crystallography, optics, geology and chemistry, and received the degree of Doctor of Philosophy in 1901.

In 1904 he was called to the University of Michigan as assistant professor of mineralogy. His advancement from the start was exceedingly rapid for in four years his title read Professor of Mineralogy and Petrography and Director of the Mineralogical Laboratory. Under his leadership the department grew rapidly because of his energy, enthusiasm and foresight.

In addition to being a stimulating teacher, Dean Kraus possesses rare executive and administrative abilities. He has, therefore, been called upon frequently to serve the University in various additional capacities: as secretary of the Graduate School from 1908 to 1912; from 1911 to 1915 he served as Acting Dean of the Summer Session and from 1915 to 1933 as Dean; in the College of Pharmacy he was Acting Dean from 1920 to 1923, and Dean from 1923 until 1933. In 1933 he was appointed Dean of the College of Literature, Science, and the Arts, the largest single administrative unit of the University with an enrollment of approximately 5000 students. Because of his manifold duties in this new position he was relieved of all formal teaching although he continued to keep in close touch with the advances in mineralogy and frequently returned to his private office in the Department where undisturbed he continued some of his investigations.

Shortly he will retire from all administrative duties and I understand he is looking forward with keen delight to the time when he again can devote his entire attention to writing and research.

Dean Kraus is a fellow of the Mineralogical Society of America (President in 1920), the Geological Society of America since 1902, and the American Association for the Advancement of Science. He also holds membership in the American Chemical Society, Optical Society of America, American Institute of Mining and Metallurgical Engineers, Michigan Academy of Science, Arts and Letters (President 1920), American Pharmaceutical Association, American Association of Colleges of Pharmacy (President 1926), and for ten years (1930–1940) served on the committee on the revision of the U. S. Pharmacopea. He is an

honorary fellow of the American College of Dentists and honorary member of the German Mineralogical Society, the Gemmological Association of Great Britain, and the Gemmological Institute of America.

Although burdened for a long period by many time-consuming administrative duties, he still found opportunity to contribute liberally to mineralogical literature. His list of scientific publications approximates 75 papers covering a wide range of subjects relating to the occurrence and origin of minerals, crystallographic forms observed on crystals, and new apparatus to determine specific properties of minerals and rocks. In more recent years his attention has been concentrated on the variation of hardness of the diamond and its industrial applications. Also fourteen papers have appeared by Dean Kraus dealing with educational trends and policies.

In addition to this long list of papers, he is the sole author of two and co-author with his colleagues of three texts on Crystallography, Descriptive and General Mineralogy, Gems and Gem Materials and Tables for the Determination of Minerals. As text books on the college level they have unquestionably stimulated interest in minerals and gems, and judged by their sales through the years have demonstrated great vitality.

One of the highest honors that can be conferred by the University of Michigan on a member of its faculty came to Dean Kraus very recently when he was awarded the Henry Russel Lectureship for 1945, in recognition of his outstanding work in the fields of crystallography and mineralogy. The selection of the recipient of this Lectureship is made each year by the University Research Club.

Dean Kraus, the Society on this commemorative occasion expresses its gratitude for the innumerable services you have rendered. The Society also wishes to pay tribute to you as an inspiring teacher, an able organizer and administrator, a painstaking investigator and successful author. Your labors in behalf of our science have extended over a period of forty-five years. The Mineralogical Society desires to express its high regard in which you are held by your associates and to formally recognize your accomplishments by bestowing on you the highest award that the Society has at its disposal. For in the truest sense and in the broadest meaning of the phrase you have earned it by "meritorious achievement."

It is indeed both a privilege and pleasure for me, who has been so closely associated with you for so long a time, to have been asked by the Council to carry out their wish of presenting to you the Roebling Medal.

ACCEPTANCE OF THE ROEBLING MEDAL OF THE MINERALOGICAL SOCIETY OF AMERICA

EDWARD H. KRAUS,
University of Michigan, Ann Arbor, Michigan.

Today we celebrate the 25th anniversary of the founding of the Mineralogical Society of America. To be the recipient of the Roebling Medal on this occasion is indeed a signal honor. It is with sincere appreciation and with deep humility that I accept this medal presented to me on behalf of the Society by Professor Walter F. Hunt, my colleague and friend and immediate associate in the development of mineralogy at the University of Michigan during the past forty years.

At anniversay celebrations such as this, it is considered appropriate to review the accomplishments of the organization. The events that led to the founding of the Society were briefly referred to by Professor Hunt. They were, moreover, given in considerable detail in the first presidential address of the Society entitled "The Future of Mineralogy in America" which I delivered in Chicago in 1920, and at the annual meeting in 1929 the progress made by the Society during its first decade was reviewed. In 1937 at the Washington meeting, I had the honor of presenting on behalf of the Society the first Roebling Medal to Professor Charles Palache of Harvard University, the Dean of American mineralogists. Later, it was my privilege to contribute to the anniversary volume of the Geological Society of America the chapter on mineralogy in which the advances made in our science in the 50 years, 1888 to 1938, were discussed. Thus, the literature now extant covers rather adequately the general developments in mineralogy and the progress of the Mineralogical Society of America up to six years ago.

These six years have been most momentous. During this period there has been waged the greatest global struggle the world has ever experienced. Since modern warfare utilizes to the utmost the achievements of science and technology, the personnel of the country in these fields has been marshalled as never before. In fact, the urgency of war requirements compelled the crowding of a stupendous effort into this relatively brief period. This effort has wrought most significant results, which under ordinary peacetime conditions would have taken two or three times as long to accomplish. In this great effort the members of the Mineralogical Society of America have been called upon to solve in the laboratory and in the field many difficult problems which involved a comprehensive knowledge of our science. The contributions of our members have been most praise-worthy. On this occasion, I shall refer briefly to some of the services rendered.

Blackstone Studios, Inc., New York

EDWARD H. KRAUS, RECIPIENT OF THE ROEBLING MEDAL OF THE MINERALOGICAL SOCIETY OF AMERICA.

One of the most important contributions to the winning of the war, in which our mineralogists played a very important role, was made in the field of radio communication. The developments in this important field in the United States, since Pearl Harbor, are remarkable. The results which have been achieved are indeed thrilling.

As is now well known, piezoelectric oscillating crystal plates are very important for effective radio communication. As early as 1880, Jacques and Pierre Curie discovered that the crystals of those minerals and chemical substances which possess polar axes of symmetry will under favorable conditions exhibit piezoelectric properties. However, it was not until toward the close of World War I that attempts were made to apply this interesting property in developing devices for the detection of submarines.

The observation that quartz crystals, which possess this remarkable property, could be made to expand and contract rapidly when placed in an electric field, was an important discovery and led to most interesting and startling uses. In 1922, Professor W. C. Cady of Wesleyan University found that this piezoelectric property could be used to control the frequencies of oscillation of radio circuits. In due time, this led to the development of crystal-controlled radio equipment. For this purpose appropriately cut thin sections of quartz crystals proved most effective in keeping sending and receiving apparatus tuned to designated frequencies.

The preparation of piezoelectric oscillating quartz plates was at first on a rather limited and more or less custom basis. The annual output was expressed in thousands. With our entrance into the war there was immediately an urgent demand for tens of millions of such oscillating quartz plates for use in the great number of airplanes to be built, and in ships, motor vehicles, and ratio sets of all kinds. As Brazil was the principal source of suitable material and the means of shipment by sea extremely hazardous because of the submarine menace, and air transportation very limited, frantic efforts were made by mineralogists and geologists to locate other occurrences of usable quartz crystals. At the same time, it became necessary not only to accelerate the speed of production but also to make use of new crystal cuts to meet the new requirements due to the greatly varying conditions encountered in operations on the ground in widely different geographic locations and in the air at altitudes up to 30,000 feet or more.

Rapid precision methods of production had to be developed. This required the services of crystallographers and mineralogists well versed in the properties of quartz, and in applying modern optical and x-ray methods. No tribute is too high to be paid to our mineralogists and to the various technologists and industrial managers who quickly made possible

the production of the many millions of oscillating quartz plates so urgently needed by our armed forces. This accomplishment must be included among the many miracles of science and technology this war has wrought. The various scientific aspects of oscillating quartz plates will be discussed in a series of papers by men who contributed so signally in making this miracle possible. These papers will constitute a symposium which it is hoped may be published in an early issue of *The American Mineralogist*.

We all sincerely regret that through the exigencies of the war, Dr. Harry Berman, one of our eminent and most promising younger mineralogists, made the supreme sacrifice. While on a trip to Great Britain on behalf of the furtherance of the use of piezoelectric oscillating quartz plates Dr. Berman met his tragic death in a plane crash at Prestwick, Scotland, on August 27, 1944.

Prior to the outbreak of the war, much of the industry of the United States was devoted to the production of heavy equipment such as locomotives, automobiles, trucks, agricultural equipment, refrigerators, and so forth, all of which are so essential to our modern mechanized civilization. Our industrial achievements in these areas have been remarkable. In fact, they have received great acclaim the world over.

Many of these industrial advances were, however, dependent upon the use of small items which had to be imported, for they were either not produced at all in this country, or only in very limited quantities. I refer especially to the use of diamonds and synthetic sapphires and rubies in industry. The United States was also largely dependent upon industries in the low countries, France, and Germany, for cut gem material.

The use of diamonds in industry has increased enormously in recent years. Large quantities of diamonds are now processed and used for wire drawing dies, for diamond-set tools, in the precision machining of metal and non-metal parts, and for diamond bonded wheels for sawing and abrasive purposes. When Germany overran Holland, Belgium, and France, the only supply of fine diamond wire drawing dies was cut off. These dies are necessary in the manufacture of precision wires, especially for those of smaller diameters. As these fine wires and filaments are absolutely essential in the manufacture of electrical and radio apparatus and in electric light bulbs, as well as in many other ways, a very critical situation developed. Accordingly, frantic efforts were at once made to produce these dies in this country. Unfortunately, there were very few persons in the United States with technical experience in this field, and those to whom the development of methods for the production of these dies was entrusted were not well trained in mineralogy and, hence, not familiar with the complex properties of the diamond. In addition, it

was only after the lapse of a considerable period that counsel and advice was sought of those familiar with the marked variation in hardness with direction and the structural properties of the diamond. However, the progress which has been made in this field is gratifying. Industry has been supplied with sufficient quantities of domestically produced diamond dies which have given adequate service.

Another remarkable achievement during this period was the development at the Bureau of Standards in Washington of an electric drilling method for the production of super-fine dies which has recently been put into commercial use. These dies are commonly designated as triple nought dies, namely with diameters as small as 0.0003 of an inch, or 3-tenths of a mil.

With regard to diamond set tools, the United States was in a very favorable condition when hostilities broke out. Highly efficient diamond-set tools had been developed by our manufacturers. The increased demands for these tools made by the war effort were readily met by the expansion of existing plants and the development of new ones. Then too, great progress was made by manufacturers of abrasives in the production of diamond bonded wheels by using crushing boart, principally from the Belgian Congo. These wheels now play a very important role in industry and their use will undoubtedly increase materially.

The use of industrial diamonds is now very widespread. In fact, they are employed, directly or indirectly, in the manufacture of many articles in common use today. Extensive research is conducted in leading industrial countries to improve the methods of using and increasing their efficiency. To disseminate information in this important field, four years ago, the *Goldsmith's Journal* of London added a section entitled "Industrial Diamond Review." The success of this new section was immediate and the interest in its articles so great that the Review was enlarged and is now issued as an independent monthly.

As already indicated, prior to the outbreak of the war, Belgium, Holland, and Germany furnished approximately 95 per cent of the world's supply of polished diamonds. In those countries there were about 40,000 diamond cutters, as compared with only about 250 in the United States, who were mainly employed in the production of quality stones. When Germany overran the low countries, our main sources of these diamonds were cut off. Efforts were then made to increase the output of polished diamonds in this country, and quantity production methods were introduced, especially for the cutting of stones of smaller sizes. As a result, the number of cutters and apprentices in this country increased rapidly for many new shops were opened.

The question is often asked whether the cutters of the United States will be able to compete successfully with those of the European countries after hostilities cease. According to current opinion, it is firmly believed that quality cutting of stones of the larger sizes in this country will continue to be profitable so long as rough material can be imported duty free and polished diamonds are subject to a 10 per cent duty. Because of the great difference in labor costs, quantity cutting of the smaller sizes, especially those known as melee, will undoubtedly encounter very strong competition from the European countries. Thus, the future of this phase of the diamond cutting industry is quite problematical.

In the manufacture of watches, chronometers, precision scientific instruments, electrical meters, and so forth, small hard bearing parts, commonly known as jewels, are extremely essential. Experience over many years has shown that jewels made of the varieties of corundum, aluminum oxide, known as sapphire and ruby, are extremely efficient. At first, natural sapphires and rubies were used in the manufacture of these jewels and bearing parts, but as their supply is limited, most of the jewels are now made from synthetic material.

The method of producing synthetic sapphires and rubies, which is now in use, was first introduced about 1902. It has since been greatly improved and at present synthetic material of high quality is available which is used to manufacture large quantities of jewels. Prior to the war all of these jewels were imported from abroad, principally from Switzerland, France, and Germany, for there were no plants in this country. As soon as hostilities broke out, we were threatened with a very critical shortage. This was due not only to the supply from abroad being greatly reduced but also because the war effort entailed the production of enormous quantities of matériel in which these jewels are most essential. Immediately, efforts were made to have synthetic sapphires and rubies produced in this country so that an adequate supply of rough material might be available for the fabrication of these greatly needed jewels.

But very few of our mineralogists had paid any attention whatever to the production of synthetic gem materials, and hence the source of information was very limited. Fortunately, at the University of Michigan, this phase of the gem industry had long been stressed. On several occasions I had the opportunity of visiting plants in Switzerland and Germany where synthetic rubies and sapphires were produced and fabricated into jewels. We were, therefore, able to furnish reliable information to the representatives of the Linde Air Products Company, Incorporated, which contemplated entering this field and is now the largest producer in this country of boules of this greatly needed synthetic product. As it was impossible to locate any refugee, who had had practi-

cal experience in one of the European plants, it was necessary for the firm to start from the beginning. Here, too, the contributions made by the various mineralogists, chemists, and physicists, who were called into consultation, have been noteworthy. Aided by these contributions, the very able research and technological staffs of the Company have wrought another miracle of production. Not only have the requirements for rough material been adequately met, but new methods of production have been developed which should prove very helpful in meeting foreign competition when the trade routes of the world are again open. It should also be noted that there are now several companies in this country fabricating the domestically produced material into jewels and bearing parts of high quality. At the present time the boules of synthetic sapphire and ruby are used primarily to meet the demands of industry, but it is expected that in due time this product will also be used for cutting and polishing stones into gems.

One of the great imperatives of the war effort has been the need to greatly expand our supplies of various strategic minerals. In the search for new occurrences of these minerals, which might prove of economic importance, the members of our Society cooperated enthusiastically. The list of those who have been or still are participating in these projects is a long one.

One of the most helpful developments in recent years, which has been greatly augmented by the war, is the pooling of information and thought by scientists in border-line fields. This has been notably true in the application of *x*-ray methods in the study of crystal structure. Crystallographers, mineralogists, physicists, chemists, and mathematicians are all involved in problems in this area of science. Several years ago it was deemed desirable that workers in these sciences, who are interested in crystal structure, should have the opportunity of meeting together and discussing their mutual problems. For this purpose, the American Society for *X*-ray and Electron Diffraction was organized in 1941. It is indeed gratifying that many fellows and members of the Mineralogical Society of America have been very active in this new organization and that one of our fellows was elected as its first President and served two consecutive terms. Members of this new society have already made many important contributions by solving some very complex problems through the concerted action of experts in several cognate fields.

From the very beginning, through its annual meetings and *The American Mineralogist*, our Society has been very successful in the furtherance of the several sciences represented by its membership. This is most gratifying. It should also be noted that during the last two decades the general public has shown greatly increased interest in things mineralogi-

cal. This has resulted in the organization throughout the country of many local and regional mineralogical clubs and societies composed largely of persons who are lovers of minerals and who desire authoritative information concerning their properties, identification, uses, and methods of occurrence and display. To aid in disseminating such information some of these organizations have established their own journals. These organizations have also stimulated interest in the art of cutting and polishing minerals for gem purposes. There are now many amateur lapidaries as well as an increased number of professional shops well equipped with modern apparatus. These shops have done much to relieve the shortage in the supply of semiprecious cut material caused by the war.

Another advance of recent years, which should be more widely recognized by professional mineralogists and geologists, is that made by progressive retailers of gems and gem materials. It was not so long ago that members of the most reliable firms of jewelers in our larger communities were not well informed concerning the properties and characteristics of the gem materials they sold, and therefore were often unable to answer intelligently many pertinent questions asked by inquiring prospective purchasers. But today, the situation is greatly changed largely due to the activities of the Gemological Society of America and the Gemological Institute, in which some of the members of our Society have been active. At present, there are retail stores in many communities with personnel well informed on the scientific aspects of gems and well supplied with instruments, such as,—refractometers, dichroscopes, specific gravity balances, diamondscopes, and sometimes even with polarizing microscopes,—which are essential for the accurate determination of physical and optical properties. It is now possible to ask questions relating to specific gravity, hardness, index of refraction, dichroism, optical character—as to whether the stone is isotropic or anisotropic, uniaxial or biaxial, positive or negative,—and receive intelligent answers. This is extremely gratifying to those of us who for many years have labored consistently to disseminate authoritative information in this important branch of mineralogy.

Twenty-five years ago the future of the Mineralogical Society of America was considered by many as being highly problematical. This opinion was held largely by those who were not closely identified with our subject. But soon a more favorable opinion developed, due in the main to the rapid increase in the number of fellows and members and the development of *The American Mineralogist*, as a leading scientific journal. In addition, the Roebling gift of $45,000 in 1926, and the excellent coopera-

tion of the Geological Society of America from the beginning as well as its financial support in recent years, have aided the Society greatly in attaining its high position among similar organizations in this field.

The concluding paragraph of my review of the progress made by the Society during its first ten years may well be repeated now, with only two slight changes. "While today we rejoice that the achievements of the Society have been so significant during the first *twenty-five* years, we are at the same time confident that the next *quarter of a century* will show equal or even greater accomplishments. This will be readily possible if we maintain the same enthusiastic interest in the science and the splendid loyalty and spirit of co-operation that have been so marked since our organization."

MEMORIAL OF HARRY BERMAN

C. S. Hurlbut, Jr., *Harvard University, Cambridge, Massachusetts.*

On August 27, 1944, Harry Berman was killed when his transatlantic plane crashed in attempting to land at Prestwick, Scotland. His untimely death at the age of forty-two has cut short a career that gave promise of being one of the most outstanding in American mineralogy.

Berman was born in Boston, Massachusetts on February 16, 1902, the son of Robert and Rebecca Berman. When he was seven years old, his father, a merchant, moved to Johnstown, Pennsylvania, where Berman completed public grade and high schools. He then attended Carnegie Institute of Technology with interest in mathematics and engineering, but for financial reasons was forced to abandon college work at the end of one year. In 1922 he became an assistant in the mineralogical section of the U. S. National Museum, where he acquired his intense and lasting interest in minerals. In 1924 he came to Harvard as museum assistant to Professor Charles Palache, then active as Professor of Mineralogy and Curator of the Mineralogical Museum. Here he began the life of research and study which occupied him until the outbreak of the war. Realizing the necessity of additional formal education, he took courses at Harvard and attended evening classes at the Lowell Institute in Boston. Thus, over a six-year period he completed college requirements and was granted by Harvard the degree of Adjunct of Arts in 1931. During the academic year 1932–33 he was awarded a scholarship for foreign travel, which he utilized in studying with J. D. Bernal at Cambridge, England, and with V. M. Goldschmidt in Göttingen, Germany. On returning to Harvard, he continued his program of part-time work and study. In 1935 he received the degree of Master of Arts, and in 1936 the degree of Doctor of Philosophy. From 1936 to 1940 he continued as Museum Assistant and was also Research Associate in Mineralogy. In 1940 he was appointed Associate Professor of Mineralogy and Curator of the Mineralogical Museum at Harvard University. He was on leave from these positions at the time of his death.

During the period of his employment in the Museum and his part-time study leading to his degree, Berman was actively engaged in research. He published his first paper in 1925 and since then has been author or joint author of thirty-six other papers. An examination of his bibliography will show the wide variety of mineralogical subjects in which he took an active interest.

Harry Berman
1902–1944

Under the guidance of Professor Esper S. Larsen, Berman early became skilled in the methods for the optical determination of nonopaque minerals and assisted so ably in the revision of Larsen's "Microscopic Determination of the Nonopaque Minerals" that the second edition appeared under their joint authorship.

Berman early recognized the importance of *x*-rays as a tool for the study and determination of minerals and set about to obtain *x*-ray equipment for the Harvard mineralogical laboratory. Many obstacles attended this project, for funds were inadequate and equipment poor. His first installation was a Coolidge-type tube powered by a cast-off transformer from a dental *x*-ray unit. The cameras used with it were borrowed. Several tubes burned out in quick succession—a disheartening procedure with such limited resources. He then changed to a gas tube, which proved to be more successful, although not without its attendant difficulties. It was not until after he had assembled it with his own hands that others were sufficiently trained to help with its maintenance and with the taking of *x*-ray photographs. From the beginning of the *x*-ray laboratory useful data were obtained and there gradually accumulated over a ten-year period structural details on several hundred mineral species. During this same time many hundred powder pictures were taken so that at present there exists through Berman's efforts a standard collection of powder photographs of a large percentage of the mineral species. To improve and extend the facilities of this laboratory was one of Berman's cherished ambitions.

Berman was always on the watch for new techniques that could be applied to mineralogical investigation. Thus one of the first Frantz isodynamic separators for the magnetic separation of mineral grains was brought to Harvard. At his suggestion and with his counsel, Dr. Cutler West developed the high index phosphorus liquids. Berman's own contribution was the development of the Berman microbalance. He recognized the necessity of accurately obtaining the specific gravity of small mineral particles so that a correlation could be made with structural data. After a prolonged search with many trials that ended in failure, he was able to adapt to this purpose a torsion balance sufficiently sensitive to give an accurate specific gravity determination on a grain weighing as little as 5 milligrams.

A logical classification of minerals based on their structure was one of Berman's consuming interests. His doctoral thesis on the *Constitution and Classification of the Natural Silicates* was based on the meager structural data available in the early thirties. A large percentage of the silicates studied since that time have been found to fall in the exact place

in the classification in which he placed them, thus showing his vision and proving that the system was well grounded.

Of all Berman's contributions to the science of mineralogy, by far his greatest was in connection with the preparation of the seventh edition of Dana's *System of Mineralogy.* From 1936 until the outbreak of the war, this project consumed most of his time. He not only gathered existing data but also did much original research, the results of which appear for the first time in the *System.* The first volume of this work, by Palache, Berman and Frondel, came off the press less than a month before Berman's death so that he saw the first fruits of a project to which he had devoted so much labor, thought and energy.

At the outbreak of the war Berman's patriotism led him to eagerly apply his knowledge of minerals and his scientific skill to the several war projects for which he acted as consultant. His first such assignment was to search for optical calcite. He combed the domestic localities and eventually located a hitherto unsuspected source of optical calcite from which many tons of high-grade material were later removed. He also visited many fluorite localities and was instrumental in locating an adequate source of that mineral to be used for optical purposes.

In September 1942 he became associated with the Reeves Sound Laboratories of New York City, when that company was beginning the manufacture of quartz crystal oscillators. Although his initial capacity was that of crystallographer, he soon turned his attention to the many other problems connected with production and was conspicuously successful in developing laboratory techniques into manufacturing processes. The enviable record made by the Reeves Sound Laboratories and the affiliated Hudson American Corporation has been due in large part to Berman's ability to solve new problems as they arose, many of which were remote from crystallography. It was while on a trip to England as a consultant in similar work sponsored by the British Government that he lost his life.

Berman did little formal teaching at Harvard but his scientific approach to problems and his research enthusiasm attracted advanced students. They found him helpful, kindly, and patient in explanation. His advice was much sought and during the past ten years the published papers and theses of students reflect his influence. Berman's death has led to a flood of letters from former Harvard students, which show how highly they regarded him as a scientist and how much they loved him as a man. A spontaneous movement to commemorate his memory is now forming among these scientists and among his associates in the war-induced mineral industries. A memorial in the form of a modern well-

equipped x-ray laboratory may result. His Harvard colleagues falter in attempting to assess their loss. His intellectual gifts were great and his scientific promise seemed unlimited. We who are left regret the loss of a great scientist and will miss Berman's stimulating and vigorous discussion of scientific problems, his skillful and ready help, his modest friendliness.

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MEMORIAL OF GEORGE LETCHWORTH ENGLISH

Robert C. Vance, *Ward's Natural Science Establishment, Rochester, New York.*

George Letchworth English who passed away on the morning of January 2, 1944, at his winter residence, Winter Park, Florida, was born in Philadelphia, Pennsylvania, June 14, 1864, to John A. and Amanda Evans English. All of his earlier years were spent in that city where his father was a publisher of theological books. On June 17, 1890, he married Louise T. Baltz. They had three children; Gwendolyn, Henry Rowland, and Katherine Louise. Mrs. English died on March 10, 1920, and on March 29, 1923, he married Jane Parsons Hanna, Head of the Chemistry Department, East High School, Rochester, New York. He is survived by Mrs. English, his son, Professor Henry Rowland English, and his daughter, Mrs. John K. Burleson.

Mr. English attended the Philadelphia Friends Central School, graduating in June 1881. It was while he was employed by a Philadelphia Insurance Company from 1881 to 1887 that he became intensely interested in minerals and decided to enter the business of collecting and selling mineral specimens. In 1887, with a partner, Edwin C. Atkinson, he opened a store in Philadelphia. His stock consisted of Arizona wulfenites, vanadinites, azurites, and malachites in addition to fine crystallized Franklin fowlerites. Expeditions which he took in 1887, '88, and '89 to Europe, Canada, and the Eastern and Western States kept his establishment well supplied with magnificent specimens. In 1890, with a third partner, William Niven, George L. English and Company moved their business to 64 East Twelfth Street, New York City. Two years later he acquired full control of the business.

He traveled extensively and a visit to Laurium, Greece, in his trip to Europe in 1891 resulted in his discovery of the mineral penfieldite, and in addition he procured an assortment of minerals which was said to have been the finest ever imported into this country at any one time.

Mr. English's exhibit at the Chicago World's Columbian Exposition in 1893, which consisted of a $20,000 collection of gems and mineral specimens, was so outstanding that he was awarded special diplomas and medals. In 1894 and 1896 other trips to European and American localities resulted in additional stocks of magnificent specimens.

In 1905 Ward's Natural Science Establishment purchased his business and stock of minerals. The period from 1887 to 1905 has frequently been referred to as the golden age of mineral collecting, largely because of the fact that newly opened mines in the lead-zinc region of Joplin, Missouri;

George Letchworth English
1864–1944

lead and copper mines in the southwest; Michigan copper mines; Franklin, New Jersey, zinc mines; in addition to numerous other discoveries of new mineral localities in various sections of the country, were producing a profusion of showy mineral specimens. It can be safely asserted that these earth treasures would not have been preserved for scientific study and for posterity if it had not been for Mr. English, and men of like vision. Also by years of hard work he proved that constant striving and seeking would produce the minerals needed to meet the demands of museums and colleges.

From 1903 to 1913 Mr. English left the mineral business and was retained by the National Light and Thorium Corporation to locate monazite deposits in North and South Carolina. In 1913 he became manager of the Mineral Department of Ward's Natural Science Establishment and from 1922 to the time of his retirement in 1934 served as their consulting mineralogist. A brief outline of some of his major accomplishments and collections that he secured during this period follows.

In 1917 he purchased the 6000 specimen collection of Mrs. Leontine A. Lowe, wife of Professor T. S. C. Lowe of Pasadena, California, formerly of Norristown, Pennsylvania. In 1918, arrangements were completed with the owners of the Virgin Valley Nevada opal mines to place on the market specimens of the beautiful precious opal of this district. Many hundreds of opals now became available to collectors. Also the T. E. H. Curtis mineral collection of 800 specimens was purchased that same year.

In 1919 the Michael Bradley, Chester, Pennsylvania, collection of 2000 specimens was acquired. In 1920 the R. W. Forbes superb mineral collection of 2500 specimens was secured. The John Graves collection of North England minerals was also imported. Mr. English made a trip to Europe this same year and bought the Otto Vautier, Geneva, collection of Swiss minerals. He also visited England, France, Italy, Austria, and Germany. Likewise the collection of Mr. K. Broadbent, Broken Hill, New South Wales, was purchased.

In 1922 another collecting and purchasing trip was made to Europe. The Dr. Robert Herzenberg of Hamburg, Germany, collection was one of the purchases. In 1923 he had the first importation of the Grootfontein descloizites, and the purchase of the G. M. Swindell collection of Bisbee minerals.

In 1924–25, as the result of another European trip, beautiful wire silver specimens were obtained at Kongsberg, Norway, in addition to specimens from the old English collections of John Ruskin, Baroness Burdett-Coutts, J. H. and Henry F. Collins, and Philip Rashleigh. The same year saw the importation of the Belgian Congo uranium minerals from the

Katanga District. Also large shipments were obtained of Russian minerals. Tasmania crocoite was likewise received.

In 1926, a trip to localities in the western states resulted in the purchase of the C. R. Winn collection of Butte, Montana, minerals and in the same year, the Rochester Collection of Meteorites was acquired. In 1927 Mr. English again sailed for Europe on a scientific collecting expedition that took him around the world. Europe, South Africa, Southwest Africa, Rhodesia, Australia, Tasmania, New Zealand, California, and Arizona were visited and minerals valued at $100,000 were acquired. In December, 1928 Mr. English exhibited and offered for sale in New York City mineral specimens valued at $40,000. This exhibit included many choice specimens obtained on the expedition mentioned above. In 1930, the Dr. Bela Fülöpp collection of Rumanian minerals was purchased.

In 1933 Mr. English introduced to museums and to collectors the NiCo lamp for producing fluorescence in minerals. This stimulated an interest in fluorescence that persists to the present time. In June 1934, Mr. English retired from active service to devote his time to the writing of his very popular book "Getting Acquainted with Minerals," which is generally considered one of the best texts for the elementary student and collector. In 1902 and 1903 Mr. English lectured on mineralogy before the Brooklyn Institute of Arts and Sciences, and also in the New York City Board of Education course. In 1903 the Encyclopedia Americana invited him to become associate editor and he wrote the section on Mineralogy for the 1904 edition.

He was a member of the New York Mineralogical Club, Philadelphia Academy of Natural Science, Rocks and Minerals Association, Mineralogical Society of Great Britain and Ireland, Fellow of the American Mineralogical Society, and in 1927 its Vice-President. He was also a life member of the Rochester Academy of Sciences, and its President from 1919 to 1921.

He recognized as new minerals penfieldite, graftonite, pyroxmangite, and skemmatite, and referred them to investigators for detailed descriptions. A rare hydrous phosphate of calcium, potassium, and aluminum from near Fairfield, Utah, was named *Englishite* in his honor.

His paper on "The scientific valuation of minerals" (*American Mineralogist*, **12**, 197–209, 1927) is still extensively used as a basis for the evaluation of mineral specimens.

In addition to being the author of the popular scientific book "Getting Acquainted with Minerals," he also wrote in 1939 "Descriptive List of the New Minerals 1892–1938." This book gives a brief summarized de-

scription of nearly 2000 minerals. He was also the author of numerous articles on minerals written for the layman.

Mr. English was an enthusiastic collector of unusual skill and ability. He will be remembered as a cultured gentleman zealous in his efforts to conserve for the scientist minerals that represent the treasures of the earth. A master of his chosen science, he took great delight in conveying to others his love for minerals. The hospitality of his home was known to men in all walks of life including many distinguished scientists, for here he found great delight in exhibiting his remarkable large collection of mineral micro-mounts. Such a visit inspired many to collect and study minerals, but his great enjoyment was to see a particularly fine mineral specimen, that he had procured, find its place in a permanent collection.

His business associates always found him very appreciative and sincere and he won their friendship, respect, and loyalty by his high regard for them.

MEMORIAL OF EDWARD BENNETT MATHEWS

Ernst Cloos, *The Johns Hopkins University, Baltimore, Maryland.*

Edward Bennett Mathews died on February 4, 1944, after a short period of failing health. He was born August 16, 1869, in Portland, Maine. His early training he received in the public school at Portland and from private instruction. In the fall of 1887 he entered Colby College and graduated with the bachelor's degree in 1891. In the fall of that year he became a student at The Johns Hopkins University and received his doctor's degree in 1894. During the field seasons from 1891 to 1894 he served with the U. S. Geological Survey under R. C. van Hise in the Marquette-Menominee area and under Whitman Cross in the Pikes Peak area. The same party made a survey of the San Juan Range, and a detailed investigation of the Cripple Creek mining district.

After graduation he was appointed instructor of Mineralogy and Petrography at The Johns Hopkins University and served the institution for almost fifty years with undiminished loyalty. In 1895 he was promoted to the rank of associate, to associate professor in 1899, and he became professor in 1904. He succeeded W. B. Clark as chairman of the department in 1917. He retired in 1939 at the age of 70 with the title professor emeritus.

After the organization of the Maryland Geological survey in 1896 he became assistant state geologist and succeeded W. B. Clark as director, serving the State until his retirement in 1943. In the first publication of the survey he is represented with an article on "Bibliography and Cartography of Maryland" to be followed by many others. Not all of these publications are geological but every one represents a labor of love in service to the public. Under his guidance the survey published many of the well known green volumes and many topographic and geologic maps of the State. Of the twenty-two Maryland counties, seventeen are covered by geologic maps and the topographic maps cover the entire State. This map work has been of immense value to many. As assistant state geologist he mapped the vicinity of Baltimore and large portions of the adjacent counties, mostly traveling on foot and in a buggy. His interpretations were later incorporated in the published county maps. He knew the State well and could refer to many localities and their geologic situation at a moment's notice. He served on many committees and boards and they all took advantage of the large store of information which he had accumulated, not only on geology but also on education, administration, history, and geography, and nobody who sought advice left empty-handed.

EDWARD BENNETT MATHEWS
1869–1944

In 1919, Dr. Mathews became chairman of the committee on Natural Resources of the Maryland Council of Defense. He was chairman of the Division of Geology and Geography of the National Research Council from 1919 to 1922, and of the Advisory Council of the U. S. Board of Surveys and Maps from 1920–26. He belonged to the Board as long as he was in the service of the State. In 1923, he represented the National Academy of Sciences and the National Research Council at the International Research Council at Brussels and took part in the meetings of the 13th International Geological Congress where he was elected vice president. A year later, he was elected president of the Association of American State Geologists. He participated also in the International Geological Congresses at Madrid and in South Africa and was treasurer of the 16th Congress held at Washington, D. C. In 1928, he was appointed the Maryland representative on the location of the boundary line along the Potomac River between Virginia and Maryland. In 1930, he attended the French Centennial celebration of the Geological Society of France. In 1931, he became a member of the committee on States Relations of the National Research Council and of the committee on batholiths, as well as a member of the special committee for the preparation and making of an atlas in connection with the memorial volume by the George Washington Bicentennial Commission. In 1932, he became chairman of the special committee on the coal industry in Maryland, in addition to other duties in connection with the directorship of the State Weather Service, membership in the Maryland Development Commission and the Water Resource Commission. In many of these bodies he retained membership up to his resignation.

His services to the University were many, some recognizable on boards and committees, but mostly invisible. He rendered the greatest service to the institution by instilling loyalty in others and by his unselfish and lavish generosity and kindness that he bestowed on all. There are endless numbers of books that he donated to the library, many of which he bought because he saw the need but did not feel that the University could buy them. He was so much a part of the department that his personal property merged with the departmental equipment and rarely, if ever, would he lay claim to it. His devotion, loyalty, and service were unlimited.

As a scientist, Dr. Mathews emphasized fundamental facts and principles. He was more interested in the general picture and the background than in a technical contribution. He was a geologist and not a mineralogist or petrographer, a philosopher and not a technician. Few men ever possessed his knowledge of geologic literature and could, like Dr. Mathews, find a citation, a paper, or a reference on such short notice

from the library. Elaborate equipment could not bribe him and an old microscope in the hands of the right man would, in his opinion, go infinitely further than technical skill and apparatus without ingenuity.

Dr. Mathews belonged to many learned societies. He contributed much effort to the treasurership of the Geological Society of America, serving since 1917. Under his watchful guidance the capital of the Society grew five-fold, a fact which was forgotten with the receipt of the Penrose bequest. He also held membership in the Mineralogical Society, the Washington Academy of Sciences, the American Academy of Arts and Sciences, the American Association for the Advancement of Science, the Society of Economic Geologists, the American Institute of Mining Engineers, the American Geographical Society, the Association of American State Geologists (President 1920–1923), and the Maryland Historical Society.

Dr. Mathews will be missed by his friends and associates, his kindness and warmth will be missing in a much larger community, and the profession has lost a member whose wide interest and perspective and general knowledge was acquired in a lifetime of hard work and thought.

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MEMORIAL OF BENJAMIN LeROY MILLER

Duncan Stewart, Jr., *Lehigh University, Bethlehem, Pennsylvania.*

Benjamin LeRoy Miller was not a mineralogist, petrologist, or petrographer in the strict use of those terms, but an eminent economic geologist and a man of unusual qualities with a host of friends. Professor Benjamin LeRoy Miller died March 23, 1944, following a heart attack in Williams Hall, Lehigh University, where for thirty-seven years he had his office. A short time prior to the attack he had returned from a six weeks' business and pleasure trip to Florida and seemed to be in excellent health.

Dr. Miller was born at Sabetha, Kansas, on April 13, 1874, the son of Jacob J. and Mary (Moorhead) Miller. He married Mary A. Meredith on September 15, 1904. She passed away May 30, 1930. He is survived by his daughter Ruth Meredith (Mrs. Otto H. Spillman) and her three children, and Ralph LeRoy, his son. He was a member of the Society of Friends.

The A.B. degree was granted him by the University of Kansas in 1897, his A.M. was taken at Penn College, Iowa, in 1898 and his Ph.D. was received from the Johns Hopkins University in 1903. In 1941 Moravian College conferred upon him the honorary Sc.D. degree.

Before coming to Lehigh University in 1907, as Professor of Geology, he had taught at Penn College and Bryn Mawr College. During a sixteen weeks' summer session, in 1943, he was on the staff of Princeton University. He had been associated with the State Geological Surveys of Kansas, Iowa, Maryland, and Pennsylvania; also the United States Geological Survey. Professor Miller was a cooperating geologist of the Pennsylvania Geological Survey from 1919 until the time of his death, and a consulting geologist for many cement companies in the Lehigh Valley. He was also the consultant for the Wild Creek Gravity Water Supply System that now supplies the city of Bethlehem.

Dr. Miller was affiliated with the Mineralogical Society of America, being elected to Fellowship in 1922; Sigma Xi (University of Kansas, 1896); Iowa Academy of Sciences (1899); American Association for the Advancement of Science (1901); the Geological Society of America (1904); American Institute of Mining and Metallurgical Engineers (1911); Seismological Society of America (1911); Society of Economic Geologists (1920); Pennsylvania Academy of Sciences (1924); Geological Society of London (1926); and Tau Beta Pi (Lehigh University, Honorary). He was consulting Editor for the *Engineering and Mining Journal*, 1920–1922. Dr. Miller was honored in 1942 by being selected as Chairman of the Industrial Minerals Division of the A.I.M.E.

Benjamin LeRoy Miller
1874–1944

Fortunately, Professor Miller was in such a position that it was possible for him to travel extensively. In 1927 he circled the world, and again in 1937, when he attended the International Geological Congress at Moscow, returning to the States by way of China and Japan. Other trips were made to Great Britain and Ireland; to central Europe; to Spain to attend the International Geological Congress; to Scandinavia; to South America in 1915; to Alaska in 1940; and to Central America in 1941. His trip to South America was followed in 1919 by the publication of *The Mineral Deposits of South America*, which he wrote in collaboration with Professor Joseph T. Singewald, Jr.

With the passing of Dr. Benjamin LeRoy Miller the geological sciences lost a very active geologist as may be noted from the appended selected bibliography.

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MEMORIAL OF FRANK CHARLES SCHRADER

WALDEMAR T. SCHALLER, *U. S. Geological Survey, Washington, D. C.*

Widely known throughout the west as the prospector's friend, Frank Charles Schrader passed away in April, 1944. He was ever ready to help the individual miner and prospector in identifying his various rocks and minerals and to supply him with publications that would help in his search for metals and ores.

Born in Sterling, Illinois, on October 6, 1860, he received the degrees of Bachelor of Science and Master of Science from the University of Kansas and Bachelor of Arts and Master of Arts from Harvard. Before joining the U. S. Geological Survey in 1896, he served as entomologist in Kansas (1889–1891), on the State Board of Agriculture, Massachusetts (1893–1894), and taught geology for a year at Harvard (1895–1896). He was one of the first Federal geologists to make explorations in Alaska, reporting on the Copper River district, the Cape Nome gold region, and other areas. Later, he reported on the mineral resources of Kansas, New Mexico, Colorado, Arizona, Idaho, Nevada, and other western states, publishing many papers on ore and mineral deposits in these States. In 1917 he assisted in the revision of an earlier bulletin of the Survey on "Useful Minerals of the United States." During the First World War he examined and reported on many mineral deposits in the East and became the Mineral Resources specialist on antimony. His interest lay largely in the West, however, and he soon returned there for field work, particularly in Nevada.

He examined and reported on many mining properties and was chief witness in important mining cases in the Federal courts.

A keen mineralogist, he always brought back from the field any minerals that seemed unusual or worthy of further study, and gladly contributed both material and his time to others. The writer has benefited greatly by Schrader's generous contribution of material and by informal discussions of problems with him. He was always pleased to be of help to others and gratified that, indirectly perhaps, he had contributed to the work of others.

He was a member of many scientific societies: American Association for the Advancement of Science, Society of Economic Gelogists, American Institute of Mining and Metallurgical Engineers, Mining and Metallurgical Society, American Forest Association, Geological Society of Washington, Washington Academy of Sciences, Washington Petrologists Club, and a Fellow of the Geological Society of America and Mineralogical Society of America.

Frank Charles Schrader
1860–1944

Long a bachelor, he married Kathrine Batwell in 1919. In 1932 he was retired from active service on account of age but for five more years he continued to turn out geological reports.

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MEMORIAL OF GEORGE STEIGER

JOSEPH J. FAHEY, *U. S. Geological Survey, Washington, D. C.*

After a long period of poor health, death brought to a close the fruitful career of George Steiger on April 18, 1944, in Washington, D. C. His passing preceded by only ten hours that of his lifelong friend and co-worker, Dr. Roger C. Wells.

Steiger was born in Columbia, Pa., on May 27, 1869. His family soon after moved to Washington, D. C., where he attended the public schools and received the Bachelor of Science and Master of Science degrees in 1890 and 1892, respectively, from Columbian College, now George Washington University.

He joined the staff of the United States Geological Survey as a chemist in 1892, just before the drastic curtailment of personnel due to a greatly reduced appropriation. In addition to Chief Chemist, Professor F. W. Clarke, George Steiger and W. F. Hillebrand were the only chemists retained, because, as Steiger later remarked "Hillebrand was the best chemist and he (Steiger) was the lowest paid."

In 1916 Steiger became Chief Chemist and held that position until 1930, when at his own request he was relieved of the duties of administration in order to devote all of his time to research in the field of spectrography. This he continued for several years after his retirement from active service in 1939 until a rapidly worsening heart condition made it necessary for him to terminate completely his professional activity.

George Steiger's chief interest was in precise chemical analytical work. His superb laboratory technique made possible his many high quality rock and mineral analyses which have enriched the literature over a period of almost four decades. His bibliography records the work of a great chemist, but it throws no light on the inestimable help he gave to others, particularly to his younger associates, in solving their laboratory problems. His kindly counsel was at all times available and most frequently sought. Neither does his bibliography record the immense amount of analytical data he furnished, especially the long series of rock analyses for numerous geologists.

Steiger remained a bachelor throughout his life. Until failing health in his later years forced upon him curtailment of physical activity, he long had been a devotee of pursuits that brought him in close contact with the woods and waters around Washington. Chief among these was boating. He was the proud owner of a houseboat and several motor-driven boats, which were berthed on the old Chesapeake and Ohio Canal and on the Potomac River. A charter member of the Sycamore

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Island Boat Club, he was ever ready to tell of his experiences camping and boating along the waterways around Washington.

He described (with Larsen) sulphatic cancrinite and the new chlorite griffithite. The mineral steigerite, a hydrous aluminum vanadate, was named in his honor.

He was a charter member of the Geological Society of Washington, founded in 1892, and a member of the American Chemical Society for more than fifty years. He also was a Fellow of the Mineralogical Society of America and the American Association for the Advancement of Science, and a member of the Washington Academy of Sciences, the American Institute of Mining and Metallurgical Engineers, and the Cosmos Club.

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MEMORIAL OF JOSEPH ELLIS THOMSON

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The sudden death of Joseph Ellis Thomson from cerebral haemorrhage on Tuesday, September 26, 1944, came as a sad shock to his colleagues and numerous friends and acquaintances. He had gone about his regular duties during the day and engaged in a pleasant conversation with the writer in the afternoon. He spent the evening with his wife and on retiring for the night complained of a pain in his neck. About fifteen minutes later he said that he felt very bad and the doctor was called. He passed away just after asking a question of the doctor in regard to the treatment.

Joseph Ellis Thomson was born July 27, 1882, at Toronto, Ontario, the son of Daniel Edmund and Elizabeth Hosking Thomson. He made his home in Toronto for his entire life time, except for brief intervals when he was absent for advanced study and a short period when he was engaged in the practice of Mining Engineering.

His hosts of friends included all with whom he was thrown in contact from early childhood, through schools, universities, professional societies, and social organizations, and his passing brings a feeling of sadness to all who knew him.

His early education was in the Model School, Toronto, and the Woodstock Baptist College from which latter institution he entered the School of Practical Science, which before his graduation became the Faculty of Applied Science and Engineering of the University of Toronto, where he studied Mining Engineering and took the degree of Bachelor of Applied Science in 1907. At intervals after his graduation he took advanced work at Columbia University, the "Sächsige Bergakademie" in Freiberg, the University of Heidelberg, and Harvard University, from which latter institution he received the degree of Ph.D. in 1929.

As an undergraduate he devoted some of his summers to work with the Crow's Nest Pass Coal Company and for a short time after his graduation was employed by the Sterling Coal Company of West Virginia.

The work for which Professor Thomson is best known began with his appointment at the University of Toronto in 1912, where he was successively Demonstrator in Mineralogy (1912–14), Lecturer (1914–21), Assistant Professor (1921–29), Associate Professor (1929–33), Professor (1933–44), and Head of the Department (1943–44).

Early in his scientific career he devoted many of his summers to field work for the Ontario Department of Mines (1910, 1915, 1916) and the Geological Survey of Canada (1918–26), but discontinued this practice

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in order that he might give a continuous service to the mining industry in the microscopic examination of rocks, ores, and mill products.

In his teaching he was brought more intimately in contact with the students in Engineering, to whom he presented the subject in a manner that would enable them to use it to the best advantage in their professional work.

He was widely known among the mining fraternity in Canada for the excellence of his work, more particularly in the investigation of the opaque ore minerals, in which field he was one of the pioneers in Canada, and was held in high esteem by his colleagues throughout the world. His published papers number about fifty but the confidential reports undoubtedly cover a greater period of study.

In his native city, aside from his university work, he will probably be remembered longest and most gratefully by the Royal Canadian Institute and the Toronto Branch of the Canadian Institute of Mining and Metallurgy, both of which organizations have reason to thank Professor Thomson for his active interest in their welfare, which resulted in greatly increased membership and a sound financial policy. He was active in many community enterprises, being particularly valuable where appeals for financial support were being made or where sound judgment was required. The qualities which facilitated his efforts in this line were directly traceable to his home influences, which involved a certain amount of informal legal education from his father, a prominent lawyer in the city, and a careful training by his mother, which made him a welcome addition to any social group. He was one of the rare men who are given honor in their own city. As one who sat at the same desk with Professor Thomson for a quarter of a century, it is the writer's privilege to say that he deserved every honor that came to him.

On September 11, 1923, he married Edith Marion Dalton, daughter of Mr. and Mrs. C. C. Dalton of Toronto. Together they won a high place in the esteem of those with whom they came in contact.

Professor Thomson was an indefatigable worker, but after the proper time for work had passed he was apparently able to put work completely out of his mind and devote his attention to the type of relaxation most suited to restore mind and body to a proper condition for carrying on his many activities. In early life he was an ardent fisherman and each spring when academic duties were finished he usually spent a week at some favorite lake or river to enjoy this sport before engaging in his summer work. For some reason he discontinued his fishing trips about fifteen years ago and indulged in golf, which offered greater opportunities for social intercourse and gave him the incentive to equal or excell his competitor's record. The hobby to which he devoted most of his spare

time in later years was gardening and his extensive collection of rare dahlias received his attention both winter and summer so that he had an exceptionally fine display, both at his city home and his summer residence, which with characteristic generosity he shared with his friends.

He prized his Fellowship in this Society, of which he was a Charter Fellow, and was seldom absent from the annual meeting, which profited by papers presented by him and by frequent discussion of the papers of others. That the Society held him in high esteem is shown by the honors they gave him: Councillor (1928–31), Vice-President (1935), President (1938).

The breadth of his professional interests and the high esteem in which he was held by his colleagues is shown by the societies of which he was a member:

Member of the Mineralogical Society of Great Britain and Ireland, Fellow of the Geological Society of America (Vice-President 1939), Member of the Society of Economic Gelogists, Member of the Canadian Institute of Mining and Metallurgy (Secretary, Toronto Branch, 1921–24, Chairman 1924), Fellow of the Royal Society of Canada, Member of the Walker Mineralogical Club (President 1940–41, Councillor 1938–44). Member of the Association of Professional Engineers of Ontario.

Societies of a more popular type include the Royal Canadian Institute (Secretary 1927–31, Vice-President 1931–35, President 1935-38), The British Association for the Advancement of Science, The English Speaking Union (President, Toronto Branch, 1943).

On the social side he was a member of the Faculty Union, University of Toronto (Secretary-Treasurer, 1931–35, Vice President, 1936–37, President 1939), the Empire Club, the Canadian Club, the York Downs Golf Club. He was an active member of the Park Road Baptist Church.

Professor Thomson is survived by his wife and by two sisters, Mrs. E. G. Long and Miss Winnifred Thomson, both of Toronto.

The simple funeral service, which was followed by interment in Mount Pleasant Cemetery, was held in the Park Road Baptist Church, Toronto.

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It is believed that the following bibliography includes all important publications of Professor Thomson. There is a certain amount of confusion in published bibliographies which attribute certain articles by J(ames) E. Thomson to Joseph Ellis Thomson and possibly *vice versa*. The writer is certain that everything that is included here was the work of Professor Thomson.

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MEMORIAL OF ROGER CLARK WELLS

WALDEMAR T. SCHALLER, *U. S. Geological Survey, Washington, D. C.*

Roger Clark Wells, third Chief Chemist of the United States Geological Survey, died suddenly from a heart attack early in the morning of April 19, 1944, in the same hospital, where 10 hours earlier his predecessor, former Chief Chemist George Steiger had passed away. His death was most unexpected. I saw him the preceding Sunday; he looked very tired but he was cheerful and energetic, as always. No one thought the end was so close.

Dr. Wells was born at Peterboro, New York, October 24, 1877, son of Byron Wells and Lucy (Clark) Wells. He graduated from Harvard in 1901 and received his doctorate there three years later, working on the atomic weights of sodium and of chlorine, under Professor T. W. Richards. This early training in exact analytical chemistry is reflected in all his later analyses, all done with meticulous attention to accuracy. After holding instructorships at Harvard and Pennsylvania, and a year as research chemist with the General Electric Company, he was appointed physical chemist on the Geological Survey in 1908, becoming Chief Chemist in 1930.

Probably because of his early work on the atomic weight of sodium, he always retained a strong interest in that element and became Mineral Resources specialist on soda and sodium compounds. Later, with R. E. Stevens, he developed methods for the separation and determination of the rare alkalies.

His contact with the mineralogical work of the Survey evoked a strong interest in the chemical composition of minerals, especially those containing the less common elements, such as columbium, tantalum, zirconium, uranium, thorium, the rare earths, and the rare alkalies. His analysis of strüverite (bibliogr. no. 16) from South Dakota served as an introduction to the difficulty of analyzing minerals containing columbium, tantalum, and titanium and he carried out a vast number of researches into methods, before he was satisfied with the results. The atomic disintegration of uranium and the resultant products, and the application of the lead uranium ratio as a means of calculating the age of the earth, fascinated him and he served on the National Research Council, Division of Geology and Geography, Committee on Measurement of Geologic Time, for several decades. In the Council, he also served on the Committee on Sedimentation from 1919 to 1935 and on the Committee on Processes of Ore Deposition from 1928 to 1935. In 1916 he examined potash deposits in Chile and in 1920 he was a delegate to the First Pan-Pacific Scientific Congress in Honolulu.

Roger Clark Wells
1877–1944

His office copies of the standard text books—those on analytical chemistry, Dana's Mineralogies, Clarke's Data of Geochemistry—are full of his written comments, notes in the text, on the margins, and on small slips of paper pasted in. His sets of his own publications, likewise, are full of such amending notes and comments, for he was ever anxious to have the latest and best data possible. These publications, with his written-in notes, are among the Chemical Laboratory's most cherished possessions.

Wells was co-author of the papers describing the new minerals lorettoite, creedite, tungstenite, and brannerite, and he contributed many careful analyses of other minerals of complex composition.

Dr. Wells was a member of many scientific societies, among them the Washington Academy of Sciences in which he served as vice-president in 1923 and 1938. He was President of both the Washington Section of the American Chemical Society and the Geological Society of Washington. He also was a member of the American Institute of Mining and Metallurgical Engineers, and a Fellow of the American Association for the Advancement of Science, the Geological Society of America, and the Mineralogical Society of America. He was a member and former Elder of the Chevy Chase Presbyterian Church, and belonged to the Cosmos and Harvard Clubs of Washington and the Chevy Chase Citizens Association.

The administration of an increased chemical staff, with urgent war demands for a greatly increased output, placed a heavy burden on him in recent years. Yet, he remained the same kindly, cheerful, and conscientious leader, with no indication to his associates of the strain under which he was working. Ill but a week, his sudden death is a reflection of that strain.

In 1914 he married Etta May Card of Syracuse, New York, who, with two sons, Arthur Byron Wells and Roger Clark Wells, both in the service, survive him.

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MINERALOGICAL SOCIETY OF AMERICA PROCEEDINGS FOR 1944

C. S. Hurlbut, Jr., *Secretary.*

Because of the situation created by the war no meeting of the Mineralogical Society of America was held in 1944, nor was there a meeting of the Council of the Society. However, arrangements were made to hold a meeting of the Council in New York City in February 1945.

The various reports of the officers of the Society for the year 1944 are submitted herewith together with abstracts of two papers presented by title.

Election of Officers and Fellows for 1945.
Reports of the Secretary, Editor, Treasurer and Auditing Committee.
List of Former Officers and Meeting Places of the Society.
Correspondents, Fellows, Members, and Subscribers of the Mineralogical Society of America.

ABSTRACTS OF PAPERS PRESENTED BY TITLE

Nepheline Syenites of Wausau, Wisconsin

R. C. Emmons, *University of Wisconsin, Madison, Wisconsin.*

The area in which the nepheline occurs is one in which the roof of the Wisconsin batholith is truncated by the erosion surface and is characterized by alternating roof pendants and cupolas. Some of the cupolas are areas of aplite and one is an area of syenite aplite, several miles across. This syenite aplite is sheared along definite fault lines of parallel trend. These faults are intruded by igneous material which is apparently refused syenite aplite. The intrusive material is syenite and nepheline syenite. Some of these dike rocks carry commercial quality nepheline and feldspar.

Groutite, $HMnO_2$, a New Mineral of the Diaspore-Goethite Group

John W. Gruner, *University of Minnesota, Minneapolis, Minnesota.*

This new manganese mineral occurs in vugs in the iron ores of the Cyuna range in Minnesota. Beautiful groups of crystals have been obtained. The crystals are flattened normal to c, and the faces are usually rounded, resulting in wedge- or lens-shaped individuals. The zone [001] is striated. Axial ratio $a:b:c=0.4262:1:0.2663$. Unit cell, $a_0=4.56$Å, $b_0=10.70$Å, $c_0=2.85$Å. The cleavage is very perfect parallel to {010}, less so parallel to {100}. G.=4.14, theoretical density=4.172. Color, jet black; Streak, dark brown. The luster is splendent submetallic to adamantine. Pleochroism is strong. The mineral has been named in honor of Professor Frank F. Grout.

ELECTION OF OFFICERS AND FELLOWS FOR 1945

There were 369 ballots cast for officers of the Society as nominated by the Council. The following were elected:

President: K. K. Landes, University of Michigan, Ann Arbor, Michigan.
Vice-President: George Tunell, Geophysical Laboratory, Washington, D. C.
Secretary: C. S. Hurlbut, Jr., Harvard University, Cambridge, Massachusetts.
Treasurer: Earl Ingerson, Geophysical Laboratory, Washington, D. C.
Editor: Walter F. Hunt, University of Michigan, Ann Arbor, Michigan.
Councilor, 1945–1948: R. E. Grim, Illinois Geological Survey, Urbana, Illinois.
Councilor, 1945–1946: Michael Fleischer, U. S. Geological Survey, Washington, D. C.

According to the provisions of the constitution, the following have been elected to fellowship:

Barnes, Virgil E., University of Texas, Austin, Texas.
Goddard, Edwin N., U. S. Geological Survey, Washington, D. C.
Hutton, Colin Osborne, Geological Survey of New Zealand, Wellington, New Zealand.
Lemmon, Dwight M., U. S. Geological Survey, Washington, D. C.
Nagelschmidt, Gunther, Rothamsted Experimental Station, Harpenden, England.
Park, Charles Frederick, Jr., U. S. Geological Survey, Washington, D. C.
Phemister, Thomas Crawford, University of Aberdeen, Aberdeen, Scotland
Switzer, George, Yale University, New Haven, Connecticut.
Wahlstrom, Ernest E., University of Colorado, Boulder, Colorado.
Wayland, Russell G., Army and Navy Munitions Board, Washington, D. C.

REPORT OF THE SECRETARY FOR 1944

To the Council of the Mineralogical Society of America:

	1943	1944	Gain	Loss
Correspondents	6	6	—	—
Fellows	209	211	10	8
Members	462	522	88	28
Subscribers	288	313	32	7
	965	1052	130	43

A net gain of 2 fellows, 60 members and 25 subscribers gives a total gain for 1944 of 87 This substantial gain gives a grand total of 1052, the highest since the founding of the Society and the second time it has passed the 1000 mark. The closest approach was 1042 in 1939. This increase is remarkable for it has taken place despite the many dislocations brought about by the war.

The Society lost through death the following eight fellows during 1944:

Harry Berman
George L. English
Edward B. Mathews
Benjamin L. Miller
Frank C. Schrader
George Steiger
Ellis Thomson
Roger C. Wells

This is the largest number of fellows to have died in any one year in the history of the Society. Their loss will be felt keenly, for many of them had been extremely active.

In the spring of 1944 Paul F. Kerr resigned from the Secretaryship of the Society, an office he had held faithfully for a decade. The Society owes Professor Kerr a debt of gratitude for so ably performing the duties of Secretary during that time. Cornelius S. Hurlbut, Jr. was appointed by the Council to complete the unexpired term of Professor Kerr. Even though out of office, Professor Kerr has been most helpful to the present Secretary in tutoring him in his duties.

Respectfully submitted,

C. S. HURLBUT, JR., *Secretary*

REPORT OF THE EDITOR FOR 1944

To the Council of the Mineralogical Society of America:

As indicated in the editor's report of a year ago, due to the diversion of much of our man power to efforts pertaining either directly or indirectly to the war, and the consequent decrease in the number of manuscripts received, it became necessary, as an emergency measure, to issue the Journal bimonthly instead of monthly.

During 1944 we have continued this policy as the causes which made the change necessary in 1943 still exist. The partial drying up of our usual sources of manuscript supply is responsible for the reduced size of the current volume as the material received during 1944 was considerably less than that sent in the preceding year. Every effort will be made in 1945 to continue the Journal on a bimonthly basis and from present indications there is some assurance that this can be done.

Dr. Frondel, director of research at the Reeves Sound Laboratories, has suggested that an issue might be devoted exclusively to a symposium on quartz oscillator-plates. He is in a unique position to assemble a group of papers dealing with this interesting and very important industry. Such an issue, according to present plans, would probably run several times the size of a normal issue and contain more than the usual number of illustrations. Outside financial assistance would be forth-coming due to the size and unusual character of this special number.

A valid criticism that might be made, especially with reference to certain issues of 1944, was the lack of sufficient diversity in the types of articles selected. Keeping in mind the wide interests and training of our large membership, papers of a varied character seem highly desirable in each issue in order to hold the interest of the largest possible number of readers. But when material is limited, as it was during the current year, selection must be confined to what is on hand and an unbalanced number is likely to result. A larger stock pile to draw upon would be the best remedy for this condition.

Recognition and appreciation is here again expressed for the financial assistance received during the year from the Geological Society of America to help defray publication costs.

In an analysis of the Journal for 1944 we find that volume 29 contains 456 pages, exclusive of index. This represents a substantial decrease in size compared with the volume of the previous year, in fact it is the smallest volume issued by the Society since 1927. Leading articles, which number 29, occupy approximately 83% of the total space of the Journal. Table 1 which accompanies this report indicates the distribution of the leading articles in the eight fields listed. It may be of some interest to point out the increasing activity in the field of structural crystallography and that the number of these articles published in the Journal in 1944 surpassed all others. If to the main articles we add six shorter papers appearing under the heading of Notes and News, we obtain a total of 35 published manuscripts for the calendar year. These contributions were received from forty contributors associated with twenty-six different universities, research bureaus and technical laboratories. The Journal for 1944 carries detailed descriptions of four new minerals: hydrotungstite, mackayite, blakeite and minnesotaite. One hundred and twenty-one illustrations of various types assist in clarifying the descriptive portions of the text. As in previous years a number of manuscripts were received from sources beyond our borders and in 1944 we printed seven of such contributions.

The accompanying table of contents summarizes in detail the subject matter in volume 29.

TABLE 1. DISTRIBUTION OF SUBJECT MATTER IN VOLUME 29

Subjects	*Articles*	*Pages*	*Per Cent of Total*
Leading articles			
Descriptive mineralogy	4		
Chemical mineralogy	5		
Structural crystallography	9		
Geometrical crystallography	3		
Petrography	3		
Optical mineralogy	2		
Mineralography	1		
Memorials	2		
	29	377.5	82.8
Short articles	6	20.5	
Notes and news	24	6.5	
Abstracts of new mineral names	36	5.0	17.2
Proceedings of societies	13	35.0	
Book reviews	10	11.5	
Total entries	118	456.0	100.0
Illustrations	121		
Index, Title page, Table of contents		8.0	
Grand total		464.0	

Respectfully submitted,

WALTER F. HUNT, *Editor*

REPORT OF THE TREASURER FOR 1944

To the Council of the Mineralogical Society of America:

Your treasurer submits herewith his annual report for the year beginning December 1, 1943, and ending November 30, 1944.

RECEIPTS

Cash on hand December 1, 1943	$ 4,317.86
Dues and subscriptions	3,352.29
Sale of back numbers	523.89
Authors' charges on separates	260.22
Sale of 20-volume index	8.66
Interest and dividends from endowment	2,788.40
Partial payments on principal of Trenton Mortgage Service Company's preferred stock	242.57
Geological Society of America Grant for 1944	1,615.26
Advertisements	214.87
Aid in publishing long papers	75.00
Honolulu Water Bonds called	45,000.00
Refund on postage	.30
	$58,399.32

DISBURSEMENTS

Printing and distribution of the Journal (6 issues)	$ 3,416.11
Printing and distribution of separates	360.85
To the Editor, Secretary, and Treasurer	970.00
Postage	138.61
Printing and stationery	96.92
Office equipment	.80
Clerical help	276.14
Committee expenses	3.22
Safety deposit box	9.60
Check returned	3.00
Roebling Medal	121.00
New securities purchased	47,331.88
Broker's commission on securities	134.74
Accrued interest on bonds bought	348.51
Postage on securities	9.20
Tax on securities	8.10
	$53,228.68
Cash balance November 30, 1944	5,170.64
	$58,399.32

The endowment funds of the Society as of November 30, 1944, consist of the following securities:

BONDS

6M Atlantic Coast Line, $4\frac{1}{2}$%	$ 5,257.50
5M U. S. Treasury, $2\frac{1}{2}$%	5,190.63
5M Illinois Central, 4%	3,887.50
5M Southern Railway, 5%	5,743.75
5M Cleveland Union Terminal, 5%	5,068.75
4C Great Northern Railway, $5\frac{1}{2}$%	400.00

PREFERRED STOCKS

55 shares, U. S. Steel, 7%	6,946.20
50 shares, Union Pacific, 4%	4,570.25
50 shares, Virginia Electric & Power Co., 5%	5,942.50
10 shares, Consolidated Edison, 5%	1,066.64
5 shares, Public Service of New Jersey, 8%	702.00
37 514/1000 shares, Trenton Mortgage Service Co.	2,209.62

COMMON STOCK

50 shares, Chesapeake & Ohio Railway	2,368.75
50 shares, Pennsylvania Railroad	1,468.75
25 shares, Standard Oil of New Jersey	1,356.25
25 shares, American Telephone & Telegraph Co.	3,369.32
	$55,548.41

NOTE: The 45 $1,000 Honolulu Water Works Bonds were called on August 24, 1944.

Respectfully submitted,

EARL INGERSON, *Treasurer*

REPORT OF THE AUDITING COMMITTEE

To the President of the Mineralogical Society of America:

The Auditing Committee has examined and verified the accounts of the Treasurer of the Mineralogical Society of America, for the fiscal year ending November 30, 1944. The securities listed in the Treasurer's report, with all future coupons on the coupon bonds attached, are in the safety deposit box at the Friendship Branch of the Riggs National Bank of Washington, D. C.

Respectfully submitted,

GEORGE T. FAUST, *Chairman*
JOSEPH J. FAHEY
GEORGE PHAIR

DANA FUND

No disbursements made during the fiscal year 1944. Interest received = $9.22. Available balance, November 30, 1944 = $934.07.

Respectfully submitted,

WALDEMAR T. SCHALLER

The Mineralogical Society of America held a luncheon at the Pennsylvania Hotel in New York City on Tuesday, February 20, 1945, the occasion being the presentation of the Roebling Medal to Professor Edward H. Kraus, Dean of the College of Literature, Science and the Arts at the University of Michigan. This luncheon was attended by about 50 members and friends of the Society. Following the luncheon the Council held a business meeting at which the reports for 1944 were presented and matters of general welfare of the Society discussed.

On February 20, 1945, the Council of the Mineralogical Society of America voted to suspend for the duration of the war the dues of fellows and members in the armed forces with the understanding that *The American Mineralogist* will not be sent to them during this time.

C. S. HURLBUT, JR., *Secretary*

LIST OF FORMER OFFICERS AND MEETING PLACES

By recommendation of the Council, a complete list of past officers is printed in the proceedings of the annual meeting of the Society:

	Presidents	Vice-Presidents
1920	Edward H. Kraus	Thomas L. Walker
1921	Charles Palache	Waldemar T. Schaller
1922	Thomas L. Walker	Frederick A. Canfield
1923	Edgar T. Wherry	George F. Kunz
1924	Henry S. Washington	Washington A. Roebling
1925	Arthur S. Eakle	Herbert P. Whitlock
1926	Waldemar T. Schaller	George Vaux, Jr.
1927	Austin F. Rogers	George L. English
1928	Esper S. Larsen	Lazard Cahn
1929	Arthur L. Parsons	Edward Wigglesworth
1930	Herbert E. Merwin	John E. Wolff
1931	Alexander H. Phillips	William F. Foshag
1932	Alexander N. Winchell	Joseph L. Gillson
1933	Herbert P. Whitlock	Frank N. Guild
1934	John E. Wolff	William A. Tarr
1935	Clarence S. Ross	Ellis Thomson
1936	William S. Bayley	Harold L. Alling
1937	Norman L. Bowen	H. V. Ellsworth
1938	Ellis Thomson	Kenneth K. Landes
1939	Max N. Short	Burnham S. Colburn
1940	William F. Foshag	Ian Campbell
1941	Frederick E. Wright	William J. McCaughey
1942	Arthur F. Buddington	Martin J. Buerger
1943	John F. Schairer	John W. Gruner
1944	R. C. Emmons	Harry Berman

Secretaries

1920–1922	Herbert P. Whitlock
1923–1933	Frank R. Van Horn
1933–1934	Albert B. Peck
1934–1944	Paul F. Kerr
1944–	C. S. Hurlbut, Jr.

Treasurers

1920–1923	Albert B. Peck
1924–1929	Alexander H. Phillips
1929–1930	Albert B. Peck
1931–1940	Waldemar T. Schaller
1941–	Earl Ingerson

Editors

1920–1921	Edgar T. Wherry
1922–	Walter F. Hunt

Councilors

1920 Arthur S. Eakle, Frank R. Van Horn, Fred E. Wright, Alexander H. Phillips.
1921 Frank R. Van Horn, Fred E. Wright, Alexander H. Phillips, Austin F. Rogers.
1922 Fred E. Wright, Alexander H. Phillips, Austin F. Rogers, Thomas L. Watson.
1923 Alexander H. Phillips, Austin F. Rogers, Thomas L. Watson, Esper S. Larsen.
1924 Austin F. Rogers, Thomas L. Watson, Esper S. Larsen, Arthur L. Parsons.
1925 Thomas L. Watson, Esper S. Larsen, Arthur L. Parsons, William F. Foshag.
1926 Esper S. Larsen, Arthur L. Parsons, William F. Foshag, William A. Tarr.
1927 Arthur L. Parsons, William F. Foshag, William A. Tarr, Alexander N. Winchell.
1928 William F. Foshag, William A. Tarr, Alexander N. Winchell, Ellis Thomson.
1929 William A. Tarr, Alexander N. Winchell, Ellis Thomson, Clarence S. Ross.
1930 Alexander N. Winchell, Ellis Thomson, Clarence S. Ross, Paul F. Kerr.
1931 Ellis Thomson, Clarence S. Ross, Paul F. Kerr, William S. Bayley.
1932 Clarence S. Ross, Paul F. Kerr, William S. Bayley, William J. McCaughey.
1933 Paul F. Kerr, William S. Bayley, William J. McCaughey, Kenneth K. Landes.
1934 William S. Bayley, William J. McCaughey, Kenneth K. Landes, E. P. Henderson.
1935 William J. McCaughey, Kenneth K. Landes, E. P. Henderson, J. F. Schairer.
1936 Kenneth K. Landes, E. P. Henderson, J. F. Schairer, Arthur F. Buddington.
1937 E. P. Henderson, J. F. Schairer, Arthur F. Buddington, Arthur P. Honess.
1938 J. F. Schairer, Arthur F. Buddington, Arthur P. Honess, R. C. Emmons.
1939 Arthur F. Buddington, Arthur P. Honess, R. C. Emmons, Carl Tolman.
1940 Arthur P. Honess, R. C. Emmons, Carl Tolman, D. Jerome Fisher.
1941 R. C. Emmons, Carl Tolman, D. Jerome Fisher, Martin A. Peacock.
1942 Carl Tolman, D. Jerome Fisher, Martin A. Peacock, Adolf Pabst.
1943 D. Jerome Fisher, Martin A. Peacock, Adolf Pabst, C. S. Hurlbut, Jr.
1944 Martin A. Peacock, Adolf Pabst, Michael Fleischer, S. J. Shand.

Annual Meeting Places

1920 Chicago, Illinois
1921 Amherst, Massachusetts
1922 Ann Arbor, Michigan
1923 Washington, D. C.
1924 Ithaca, New York
1925 New Haven, Connecticut
1926 Madison, Wisconsin
1927 Cleveland, Ohio
1928 New York, N. Y.
1929 Washington, D. C.
1930 Toronto, Canada
1931 Tulsa, Oklahoma
1932 Cambridge, Massachusetts
1933 Chicago, Illinois
1934 Rochester, New York
1935 New York, N. Y.
1936 Cincinnati, Ohio
1937 Washington, D. C.
1938 New York, N. Y.
1939 Minneapolis, Minnesota
1940 Austin, Texas
1941 Boston, Massachusetts
1942 No meeting held
1943 No meeting held
1944 No meeting held

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University of Southern California Library, University Park, Los Angeles, California.
University of Sydney, Fisher Library, Sydney, New South Wales, Australia.
University of Tennessee, Knoxville, Tennessee.
University of Texas Library, Austin, Texas.
University of Toronto Library, Toronto, Ontario, Canada.
University of Utah Library, Salt Lake City, Utah.
University of Virginia Library, Charlottesville, Virginia.
University of Washington Library, Seattle, Washington.
University of Washington, College of Mines, 324 Mines Laboratory, Seattle, Washington.

University of West Virginia Library, Morgantown, West Virginia.
University of Western Australia Library, Perth, Western Australia.
University of Wisconsin Library, Madison, Wisconsin.
University of Witwatersrand Library, Johannesburg, South Africa.
University of Wyoming Library, Laramie, Wyoming.

Valentine Garcia y Cia, Apartado 2103, Habana, Cuba.
Vanadium Corporation of America Library, Bridgeville, Pennsylvania.
Vanderbilt University, Joint University Library, Nashville, Tennessee.
Victory Shipping Company, Inc., Maritime Building, 8–10 Bridge Street, New York, New York (For Wennergren-Williams, Kungl. Veterskapsakademiens Bibliotek).
Virginia Military Institute Library, Lexington, Virginia.

Ward's Natural Science Establishment, 3000 Ridge Road East, Rochester, New York.
Washington State College Library, Pullman, Washington.
Washington University Library, St. Louis, Missouri.
Wayne Laboratories, 17 East Main Street, Waynesboro, Pennsylvania.
Wellesley College Library, Wellesley, Massachusetts.
Wesleyan College Library, 175 North Street, Middletown, Connecticut.
Western Australia Government Stores Department, Controller of Stores, Fremantle, Western Australia.
Wichita City Library, Wichita, Kansas.

Young, Henry, and Sons, Ltd., 15 North John Street, Liverpool, England.

Society of Economic Geologists

The Annual Technical Sessions of the Society of Economic Geologists, which were to have been held in New York City, February 19 to 22, were cancelled in deference to the general request by the government that meetings calling for extensive travel be cancelled when possible. However, the Annual Business Meeting of the Society and the meeting of its Council were held on February 20 in New York City. After the dinner at the Harvard Club, attended by forty-five members and guests, announcement was made of the election of the following new officers:

President Elect (1946): W. O. Hotchkiss.

First Vice-President Elect (1946): J. Terry Duce.

Councilors (1945–47): George M. Fowler, F. M. Cameron, T. G. Moore.

Regional Vice-Presidents (1945): Alfred Brammall (Europe), J. M. S. Krishnan (Asia), R. A. Pelletier (Africa), George Hanson (N. America), O. H. Leonardos (S. America), R. Lockhart Jack (Australia).

Fifteen new members were declared elected.

A brief business session was followed by an address, entitled "Economic Geology," by the retiring President John M. Boutwell.

The new officers for 1945 are: O. E. Meinzer, *President;* T. B. Nolan, *First Vice-President;* J. T. Singewald, Jr., *Treasurer;* C. H. Behre, Jr., *Secretary;* and the Regional Vice-Presidents and Councilors mentioned above.

NOTES AND NEWS

OCCURRENCE OF BOROSILICATES IN DIABASE AT LAMBERTVILLE, NEW JERSEY

W. Harold Tomlinson, Springfield, Pennsylvania.

In describing the solidification of the triassic diabases of the eastern states, petrographers usually arrange the minerals which crystallize from the magma in three groups according to the stage of solidification: (1) olivine and a few phenocrysts which crystallize from the quickly chilled magma and which are usually not found in the magma that has cooled more slowly; (2) labradorite and augite which crystallize more or less simultaneously at an early stage and are the principal constituents of the rock; (3) alkali feldspars, quartz, micro-pegmatite, apatite, sphene, etc., which crystallize at a later stage from magma left in the interstices of the labradorite-augite crystallization.

In small dikes the amount of the interstitial material (group 3) usually covers about 6% of the area of a section. In larger masses of diabase, however, the minerals of group 3 are often concentrated in pockets in blocks of solidifying magma. Crystallization within these blocks proceeds from the walls inward. As volatile constituents are concentrated the labradorite-augite crystallization becomes much coarser in grain size. This phase has been called diabase pegmatite. As magnesia and lime are depleted and alumina reduced the remaining magma crystallizes to form minerals of group 3.

The core magma of these blocks, fluid with concentration of volatile constituents, often works upward into a vein or chimney and may reach the surface of the diabase. Such pockets and veins can be seen in exposures of all the large masses of the diabase and they are well known to geologists familiar with the formation.

The volatile constituents usually present in this residual magma are water and carbon dioxide. This is inferred from the reactions found along the vein walls. In some pockets other volatile materials were present in considerable amount. Veins of scapolite in the diabase at Falls of French Creek, Pa., contain 2.45% chlorine. It would seem a reasonable inference that these veins were fed from one of these pockets formed at lower depth in which chlorine had been concentrated, the residual liquors having escaped through fractures in the already solidified mass above.

On the north wall of the quarry at Lambertville, N. J., a pocket is exposed in which boron had been concentrated. Borosilicates have been found in this diabase at many localities and their presence is not unusual, but their occurrence here is of interest because of the abundance of axinite, the variety of boron minerals formed, and their associations. The pocket is surrounded by diabase pegmatite which grades outward into diabase of finer grain. The pegmatite has a large percentage of interstitial minerals which increases rapidly toward the core. Approaching the core a brownish green hornblende takes the place of augite, then fibrous actinolite replaces hornblende. As carbon dioxide is concentrated albite and calcite take the place of labradorite. Axinite is very abundant at the core. Specimens were found up to a pound in weight in which axinite formed 30% of the rock (Fig. 1). The axinite occurs in sheaves of crystals showing the usual wedge termination, is of purple color (strong at the center but fading toward the edges), has the usual pleochroism and other optical properties. A little datolite in small, poorly formed crystals is associated with it.

Specimens taken from the quarry rubble below the pocket show an association of prehnite, tourmaline, actinolite, epidote and axinite. The upper part of the pocket was quarried out a long time ago but it would seem reasonable to suppose that these specimens collected from rubble below the pocket represent an upward extension in the form of a vein. These specimens are full of vugs which are lined with crystals of the various miner-

als. Prehnite crystals, white in color, are bounded by pinacoids forming single crystals that are optically uniform. They are quite different from the fan-shaped aggregates found in the zeolite veins. One specimen shows a replacement of tourmaline by prehnite accompanying the axinite. Apparently the axinite is stable under the alkaline conditions imposed but the tourmaline is not.

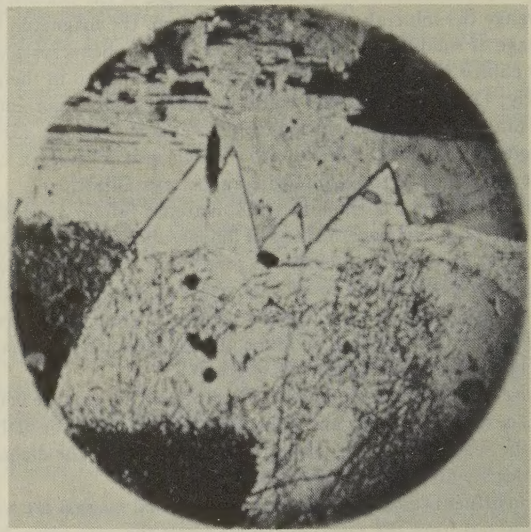

FIG. 1. Axinite wedges in albite. Black crystals, apatite; fibrous material, actinolite. × about 16 dia. Crossed nicols.

Corrections

I am indebted to Dr. H. J. Mel of the Geological Survey, Pretoria, for having called my attention to two incorrect figures of dispersion for liquids listed on pages 62 and 63 of *Memoir* **8**, *Geological Society of America*. The correct figures for $N_F - N_C$ for liquid #13, ethyl salicylate, is .0210 and for liquid #14, ethyl benzoate, is .0168.

R. C. EMMONS

Refractive Index of Western Australian Helvite

Since the publication of the paper on "Helvite and Danalite from New Mexico and the Helvite Group" by J. J. Glass, R. H. Johns and R. E. Stevens in the June number (**29**, 163–191) I have had the refractive index of the original sample of helvite from Mt. Francisco, Western Australia, checked by the immersion method using a mixture of pure methylene iodide ($n = 1.739$) and an impure sample of methylene iodide ($n = 1.759$). The refractive index of the liquid was measured in a hollow prism on a goniometer. The refractive index of the helvite was found to be 1.747. At the time when the original determination was made the hollow prism method was not available in this Laboratory. Helvite recently examined from the same or a nearby locality has the same refractive index, viz. 1.747.

H. BOWLEY, *Government Mineralogist*
Perth, Western Australia